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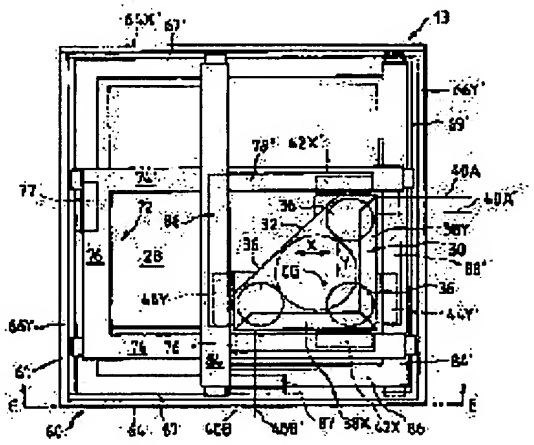
(54) POSITIONING DEVICE, ALIGNMENT DEVICE AND POSITIONING METHOD

(57)Abstract:
PURPOSE: To support an object and control the positioning so that the reaction force and the vibration caused by the motion of the object do not propagate to such an element as lens system.
CONSTITUTION: A reaction frame 61 insulating the external vibration and that caused by the reaction force from an object stage 30 is provided. The object stage 30 moves in two directions. The reaction frame is provided by two followers. Cooperating direct drive force actuators are provided on the object stage and the followers and the object stage is positioned in the first and the second directions. The reaction frame is fixed to a base structure and the object stage is supported in the space independently of the reaction frame. The follower 72 has a pair of arms 74, 74' and moves in a pair of parallel planes wherein the center of gravity of the object stage. The positioning force of actuator driving means is controlled so that the vector sum of the moments of forces at the gravity center of the object stage becomes practically zero.



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* NOTICES *

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CLAIMS

[Claim(s)]
[Claim 1] In the positioning device (a) which operates on base structure The reaction frame assembly containing the reaction frame attached in said base structure, (b) The object stage which exercises relatively to the base of an object stage, (c) The means for setting spacing from the base of said object stage, and supporting said object stage independently, with said reaction frame, (d) It is attached in said object stage and said reaction frame assembly. Become a couple for positioning said object stage, collaborate, and it has the actuator means of the direct-acting mold which generates the force. The pointing device which the base of said object stage and said object stage are insulated from the reaction force from said actuator means, and is characterized by transfer of the oscillation to the base of said object stage and said object stage serving as min by this.
[Claim 2] The positioning device with which said reaction frame assembly is characterized by having the follower who can exercise for said object stage independently and can follow it in the positioning device of claim 1.
[Claim 3] The positioning device characterized by equipping said actuator means with at least one linear motor which operates between said object stage and said reaction frame assembly in the positioning device of claim 1.
[Claim 4] the positioning device with which it has the actuator means of a lot at least in the positioning device of claim 1 in order to position said object stage, and the actuator means of these each is characterized by having the driving member attached in said object stage.
[Claim 5] The positioning device with which the vector sum of the moment of force in the center of gravity of said object stage resulting from the positioning force of said driving member is characterized by being substantially equal to zero in the positioning device of claim 4.
[Claim 6] The positioning device characterized by having at least one driving member attached in said object stage in the positioning device of claim 2.
[Claim 7] The pointing device characterized by for said follower having two arms which can exercise, respectively in two parallel flat surfaces, and the center of gravity of said object stage being between said two flat surfaces in the pointing device of claim 2.
[Claim 8] In the positioning device of claim 1 said object stage In the 1st direction, and this 1st direction and the 2nd direction which makes an include angle, it can exercise at least. The 1st follower is movable only in said 1st direction, and follows said object stage. The 2nd follower is movable only in said 2nd direction, and follows said object stage. Moreover, said actuator means to collaborate The pointing device characterized by being prepared for said object stage and said 1st and 2nd followers, and positioning said object stage in said 1st and 2nd directions.
[Claim 9] It is the positioning device characterized by having the direct-acting mold actuator which generates at least three force in which said actuator means operates between said object stage and said reaction frame assembly in the positioning device of claim 8.
[Claim 10] The positioning device with which it is prepared and the vector sum of the moment of force in the center of gravity of said object stage resulting from the positioning force of an actuator means to collaborate is characterized by being substantially equal to zero in the positioning device of claim 9 as said object stage driven in said 1st direction in two of said at least three direct-acting mold actuators.
[Claim 11] The positioning device with which the vector sum of the moment of force in the center of gravity of said object stage where one of said the direct-acting mold actuators other than said two direct-acting mold actuators is attached in said object stage, and it originates in the positioning force of said actuator means to collaborate, in the positioning device of claim 10 so that said object stage may be driven in said 2nd

direction is characterized by being substantially equal to zero.
[Claim 12] In the positioning device of claim 8, it has at least 2 sets of direct-acting mold actuators for positioning said object stage. 1 set in these direct-acting mold actuator 1 set which will position said object stage in said 1st direction, and will accept it among said direct-acting mold actuators The pointing device with which the vector sum of the moment of force in the center of gravity of an X-Y stage which positions said object stage in said 2nd direction, and originates in the location force of an actuator means to these-collaborate is characterized by being substantially equal to zero.
[Claim 13] It is the pointing device which said 1st and 2nd followers have two arms ****(ed) respectively in the pointing device of claim 8, one follower's arm is located in a single flat surface, and can exercise, and is characterized by locating the arm of the follower of another side in two parallel flat surfaces in which said single flat surface is located between them, and being able to exercise.
[Claim 14] The positioning device with which the center of gravity of said object stage is characterized by being adjacently located in the inside of said single flat surface, or the flat surface of this single in the positioning device of claim 13.
[Claim 15] In a pointing device (a) In the 2nd direction which makes an include angle in the 1st direction and this 1st direction Object stage which exercises at least (b) With the 1st follower who is movable only in said 1st direction and follows said object stage (c) With the 2nd follower who is movable only in said 2nd direction and follows said object stage (d) Pointing device characterized by having a force actuator means of a direct-acting mold to collaborate for being attached in said object stage and a list at said 1st and 2nd followers, and positioning said object stage in said 1st and 2nd directions.
[Claim 16] It is the positioning device characterized by having at least three direct-acting type force actuators with which said actuator means operates among said object stage and said each follower in the positioning device of claim 15.
[Claim 17] The positioning device with which it is prepared and the vector sum of the moment of force in the center of gravity of said object stage resulting from the positioning force of an actuator means to collaborate is characterized by being substantially equal to zero in the positioning device of claim 16 as said object stage driven in said 1st direction in two of said at least three direct-acting mold actuators.
[Claim 18] The positioning device with which the vector sum of the moment of force in the center of gravity of said object stage where one of said the direct-acting mold actuators other than said two direct-acting mold actuators is attached in said object stage, and it originates in the positioning force of said actuator means to collaborate, in the positioning device of claim 17 so that said object stage may be driven in said 2nd direction is characterized by being substantially equal to zero.
[Claim 19] In the positioning device of claim 15, it has at least 2 sets of direct-acting mold actuators for positioning said object stage. 1 set in these direct-acting mold actuator Said object stage is positioned in said 1st direction. Another side of said direct-acting mold actuators The pointing device with which the vector sum of the moment of force in the center of gravity of an object stage which positions said object stage in said 2nd direction, and originates in the location force of an actuator means to these-collaborate is characterized by being substantially equal to zero.
[Claim 20] It is the pointing device which said 1st and 2nd followers have two arms ****(ed) respectively in the pointing device of claim 15, one follower's arm is located in a single flat surface, and can exercise, and is characterized by locating the arm of the follower of another side in two parallel flat surfaces in which said single flat surface is located between them, and being able to exercise.
[Claim 21] It is the pointing device with which the vector sum of the moment of force in the center of gravity of said object stage which originates in the positioning force of a driving member of said follower having at least one driving member in each, and collaborating, in the pointing device of claim 20 is characterized by being substantially equal to zero.
[Claim 22] The positioning device with which the center of gravity of said object stage is characterized by being adjacently located in the inside of said single flat surface, or the flat surface of this single in the positioning device of claim 20.
[Claim 23] The reaction frame assembly which has the reaction frame prepared in the base and base structure of an object stage in the positioning device of claim 15, The means for supporting said each follower from said reaction frame assembly, With said reaction frame, it has a means for setting spacing from the base of said object stage, and supporting said object stage independently. By this The pointing device characterized by being constituted so that the base of said object stage and said object stage may be insulated from the oscillation produced according to each reaction force, therefore the oscillation of the base of said object stage and said object stage may become min.

[Claim 24] In alignment equipment (a) The X-Y stage which has a center of gravity, (b) The means for setting said X-Y stage from the base of an X-Y stage, and supporting spacing, (c) It has the reaction frame assembly which has the reaction frame which became independent of the base of said X-Y stage, and which was supported on the base of a reaction frame. (d) Said reaction frame assembly It has X follower and Y follower who can exercise independently who can exercise independently. an installation ****** X follower possible [motion] on said reaction frame an installation ****** Y follower possible [motion on said reaction frame] that it can exercise in the direction of X It can exercise in the direction of Y (e). Either said X follower or Y follower It has at least two ****(ed) arms. Another side of said X follower and Y follower It has at least one arm. The alignment equipment concerned further (f) It is prepared by the relation ****(ed) among said X-Y stage and said each follower. It has a direct-acting mold actuator means for the couple for positioning said X-Y stage horizontally to collaborate, and to generate the force (g). Said actuator means It is prepared in said X-Y stage to the actuator part element means formed in the arm of said follower of each, and it. It has an actuation primary-member means to collaborate with said actuator part element means, and to position said X-Y stage. The base of said X-Y stage and said X-Y stage Alignment equipment which is insulated from the oscillation produced according to reaction force, and is characterized by being constituted so that the base of said X-Y stage and the oscillation of said X-Y stage may become min by this.

[Claim 25] In the alignment equipment of claim 24, said one arm prepared for either said X follower or the Y followers Two arms which are arms of said couple which could exercise in the single flat surface and was prepared in another side of said X follower and Y follower Alignment equipment characterized by locating in two independent flat surfaces in which said single flat surface is located between them, respectively, and being able to exercise in this flat surface.

[Claim 26] Alignment equipment with which the vector sum of the moment of force in the center of gravity of said X-Y stage which has said actuator part element means formed in the arm of said couple of said one follower in the alignment equipment of claim 25, is equipped with the means for controlling it, and originates in the positioning force of an actuation primary-member means to collaborate is characterized by being substantially equal to zero.

[Claim 27] In the approach (a) for positioning an object The process which positions a reaction frame on the base, (b) Process which supports an object on an object stage (c) Said reaction frame said object independently The process which supports said object stage on space in a certain location from the base of an object stage, (d) Apply the force between said object stages and said reaction frames, and said object stage is driven in the new location of at least one direction of [on space]. The positioning approach characterized by having the process which insulates the base of said object stage from the reaction force simultaneously produced by applying said force.

[Claim 28] By the 1st follower and 2nd follower, by moving in the 1st direction and 2nd direction at least In the approach (a) of positioning an object stage to space The process which supports said object stage to space, (b) The force among said object stage and said 1st follower In addition, the process which drives said object stage only in said 1st direction, (c) The force among said object stage and said 2nd follower In addition, the process which drives said object stage only in said 2nd direction, (d) It only sets in said 2nd direction. With said 2nd follower independently The process which drives said 1st follower and is made to follow said object stage, (e) The positioning approach of the object characterized by driving said 2nd follower and having independently the process made to follow said object stage with said first follower only in said 1st direction.

[Claim 29] The positioning device with which it has a means to attach said actuator means between said object stages and said reaction frames, in the positioning device of claim 1, and this installation is characterized by the strong thing in the direction of driving force at least.

[Claim 30] The positioning device with which it has a means to attach said actuator means among said object stage and said each follower, in the positioning device of claim 15, and this installation is characterized by the strong thing in said direction of driving force at least.

[Claim 31] The positioning device with which it has in the positioning device of claim 24 with a means to attach said actuator means among said X-Y stage and said each follower, and this installation is characterized by the strong thing in said direction of driving force at least.

[Claim 32] In the precision pointing device made as [collaborate / although it has the stage which can exercise along a predetermined direction in a flat surface top] the base plate which has a flat surface -- this -- (a) The 1st support assembly for supporting said base plate on a foundation, (b) It has an actuator assembly for giving electromagnetic force to the stage in which said motion is possible along said predetermined direction. This actuator assembly is (i). The passive-movement section which is attached in the stage in

which said motion is possible, and can exercise in said predetermined direction and which can be exercised, And (ii) The actuator located in the perimeter of the stage in which said motion is possible is provided. (iii) Either said passive-movement section or said actuator has a coil unit. Moreover, another side of said passive-movement section and said actuator has the magnetic unit, and is (c) further. Said actuator is independently supported on said foundation with said 1st support assembly. By this The precision pointing device characterized by having the 2nd support assembly which forms a predetermined gap between said coil units and said magnetic units.

[Claim 33] The precision positioning device characterized by being held in the precision positioning device of claim 32 in the location where said actuator of said actuator assembly stood it still to said predetermined direction.

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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Industrial Application] Generally especially this invention relates a wafer to the approach and equipment support and for carrying out alignment and insulating the equipment from the reaction force and extraneous vibration of itself in microphone RORISO graph equipment about electromechanical collimation adjustment, i.e., alignment, and vibration isolation.
[0002]
[Description of the Prior Art] The various support devices used for a microphone RORISO graph device and a positioning device are known. In the conventional technique, generally, XY guide equipped with separate X guide assembly and Y guide assembly is used, and one guide assembly is attached possible [motion] on the guide assembly of another side. A separate wafer stage is established in the crowning of the above-mentioned guide assembly in many cases. Such structure needs the components of a high precision and many. Generally, the external force which joins the components of a positioning assembly, and the reaction force resulting from motion of the components of others of the above-mentioned positioning assembly are directly transmitted to the device which processes image formation optical system and reticle (reticle), and, as a result, produce the oscillation which is not desirable.
[0003] United States patent 5th and No. 120 or 03 (Van Engelen et al.) are indicating the pointing device of the two-step type for optical RISOGURAFU equipments, and a Lorentz force and static pressure gas bearing are used for this pointing device.
[0004] U.S. Pat. No. 4,952,858 -- electromagnetism -- the thing about the micro lithograph equipment using alignment equipment -- it is -- the above -- electromagnetism -- alignment equipment is equipped with a monolithic stage, a substage, and the criteria structure by which vibration isolation was carried out, and has supported and positioned the above-mentioned monolithic stage on space using the force actuator formed between the above-mentioned monolithic stage and a substage. In this equipment, Y frames, i.e., Y stage, are attached in an X frame, and from Y frames, the above-mentioned monolithic stage places space and is supported [above-mentioned].
[0005]
[Problem(s) to be Solved by the Invention] The overall object of this invention is offering the approach and equipment using the guide loess stage for supporting the above-mentioned object while being equipped with the reaction frame insulated from other elements like the lens system which generates the image exposed in both reaction force by the external force list produced in case an object exercises at the photoresist on the object front face of a wafer.
[0006]
[Means for Solving the Problem] The equipment of this invention is formed in a means, and an object stage and a reaction frame for the above-mentioned reaction frame to support independently an object stage, the reaction frame which an oscillation is not substantially delivered between itself and an object stage while being attached in the base, and the above-mentioned object to space, becomes a couple for positioning an object stage, collaborates, and is equipped with a direct-acting mold actuator means generate the force. An object stage is in the condition supported by space in the Z direction, and can constitute the X-Y stage which can prepare so that it may exercise in the predetermined direction, or exercises in the direction of X, and the direction of Y.
[0007] The effective description of this invention is offering support, positioning, and the assembly that carries out vibration isolation, this assembly enables the positioning function to in_which the stage of an object or a wafer should be performed, the oscillation to which a reaction is transmitted by the above-

mentioned stage and the lens system from a carrier beam stage in that case lessens quick extremely with few components, and while minimizing simultaneously the oscillation transmitted to the above-mentioned stage, the above-mentioned stage insulates from the reaction force which is not desirable.
[0008] According to another description of this invention, the positioning approach for X-Y stages and a positioning device are offered, and the above-mentioned X-Y stage is equipped with the force actuator of the direct-acting mold which is formed between the above-mentioned X-Y stage and each follower, and collaborates in X follower who can exercise independently and Y follower who can exercise independently, and a list, and, thereby, is made as [interfere / in motion of the follower of another side / motion of which follower].
[0009] According to another description of this invention, the arm of a couple is prepared for at least one follower, and as for each arm, it has a driving member, and the above-mentioned arm is located in the upper part of a center of gravity and the flat surface ****(ed) caudad of an object stage, and can exercise in this flat surface.
[0010] According to another description of this invention, the above-mentioned guide loess stage is equipped with the force actuator of at least three direct-acting molds, two of these actuators are driven in either the direction of X, or the direction of Y, and the 3rd actuator is driven on another side of the direction of X, and the direction of Y. According to the desirable example of this invention, a guide loess stage is equipped with at least four direct-acting mold actuators between an X-Y stage and a reaction frame assembly, each actuator has the driving member prepared in an X-Y stage, and this plays the role to which X driving member of a couple drives and controls an X-Y stage automatically in the direction of X, and the role to which Y driving member of a couple drives and controls an X-Y stage automatically in the direction of Y is played. It is constituted, and it is positioned and direct-acting mold actuators and these driving members are controlled so that the vector sum of the moment of force in the center of gravity of an X-Y stage resulting from the location force of a driving member of collaborating becomes equal to zero substantially.
[0011] The description and effectiveness of this invention will become clearer when the same reference mark reads the following explanation through the whole with reference to the drawing in which the same part is shown.
[0012]
[Example] it has a vibration-isolation reaction frame -- it is -- it is -- although having many applications over the device of the type with which it differs for the guide loess stage which it does not have to position [many of] an object to accuracy will be understand by this contractor , this invention explains about the desirable example of the gestalt of the microphone RORISO graph equipment for carrying out alignment of the wafer in the equipment with which a lens forms the image expose by the photoresist on the front face of a wafer . moreover, it has a vibration isolation stage -- it is -- it is -- although the guide loess stage which it does not have can be used as a guide loess object stage which can exercise only for the one direction of for example, the direction of X, or the direction of Y, the desirable example of this invention is explained about XY wafer stage of the guide loess explained below.
[0013] Reference of a drawing especially drawing 1 thru/or drawing 5 shows HOTORISO graph equipment 10 equipped with upper optical equipment 12 and the downward wafer support pointing device 13. Optical equipment 12 is equipped with the illuminator 14 equipped with the ellipsoid mirror EM which surrounds the lamp LMP like a mercury lamp, and this lamp LMP. The illuminator 14 is equipped with the optical integrator for generating the secondary light source image like the eye type lens FEL of a fly, and condenser lens CL for irradiating Reticle (mask) R by the equalized flux of light. The mask holder RST holding Mask R is attached above the lens-barrel PL of projection optics equipment 16. Lens-barrel PL is being fixed to a part of column assembly currently supported on the high arm 18 of two or more rigidity respectively attached in the crowning of the insulating pad 20, i.e., a blocking device.
[0014] The inertia block 22, i.e., an oscillating absorption block, is formed in equipment so that it may cling to an arm 18. In order to avoid conveying the structure with weight, after conveying the above-mentioned block 22 by sky condition, it can take the gestalt of the cast box which can fill up sand with an actuation site. The base 28 of an object stage, i.e., a wafer stage, is supported from the arm 18 with the hanging block 22, the hanging bar 26, and the level bar 27 (refer to drawing 2).
[0015] If drawing 5 thru/or drawing 7 are referred to, the top view and elevation of a wafer support pointing device on the base 28 of an object stage, i.e., a wafer stage, are shown, respectively, and the above-mentioned wafer support pointing device is equipped with object (wafer) X-Y stage 30 and the reaction frame assembly 60. X-Y stage 30 is equipped with the support plate 32, and the wafer 34 like a 12 inch

(304.8mm) wafer is supported on this support plate. The plate 32 is supported by the pneumatic bearing 36 of a vacuum precompression mold controllable to adjust dip, a sideslip, and a focus in the upper space of the base 28 of an object stage so that Z may be adjusted. Or in order to perform, this support, i.e., support, the combination of a magnet and a coil is also employable.

[0016] X-Y stage 30 is equipped also with the proper element which consists of the magnetic coupling means like the drive motor of a direct-acting mold again, and this element carries out alignment of the wafer to the lens of optical equipment 16, and it positions the image for exposing the photoresist of the front face of a wafer to accuracy. a graphic display -- an example -- setting -- being magnetic -- a coupling means -- an X-Y stage -- 30 -- X -- a direction -- setting -- positioning -- a sake -- X -- a drive coil -- 42 -- X -- 42 -- X -- ' -- like -- a couple -- X -- a driving member -- an X-Y stage -- 30 -- Y -- a direction -- setting -- positioning -- a sake -- a drive coil -- 44 -- Y -- 44 -- Y -- ' -- like -- a couple -- Y -- a driving member -- from -- changing -- a gestalt -- taking . The part to which the magnetic coupling means on the reaction frame assembly 60 relates is later explained to a detail.

[0017] X-Y stage 30 is equipped with the laser mirrors 38X and 38Y of a couple. The above-mentioned laser mirror 38X It operates to laser beam 40A/40A' of the couple of laser beam interferometer equipment 92. Moreover, the above-mentioned laser mirror 38Y It operates to laser beam 40B/40B' of the couple of the above-mentioned interferometer equipment, and exact XY location of the above-mentioned X-Y stage is determined and controlled to fixed Miller RMX in the lower part section of the lens-barrel PL of projection optics equipment 16.

[0018] If drawing 8 and drawing 9 are referred to, the reaction frame assembly 60 is equipped with the reaction frame 61 which has two or more support posts 62, and the above-mentioned support post is attached in a ground surface or the separate base so that an oscillation may not be substantially transmitted between this support post and an object stage.

[0019] a reaction -- a frame -- 61 -- a support -- a post -- 62 -- between -- X -- a direction -- elongating -- a field -- a plate -- 64 -- X -- 64 -- X -- ' -- a support -- a post -- between -- Y -- a direction -- elongating -- a field -- a plate -- 66 -- Y -- 66 -- Y -- ' -- having -- **** . a field -- a plate -- 64 - 66 -- the inside -- **** -- plurality -- a reaction -- a frame -- a rail -- 67 - 69 -- and -- 67 -- ' - 69 -- ' -- preparing -- having -- X -- a follower -- 72 -- and -- Y -- a follower -- 82 -- supporting -- showing around -- **** . Inside field plate 64X, the upper follower guide rail 67 and the downward follower guide rail 68 (not shown) are formed, and follower guide-rail 67' of the upper part and a lower part and 68' are prepared in the medial surface of field plate 64X' of an opposite hand. The single guide rail 69 perpendicularly arranged among guide rails 67 and 68 and 69' are prepared in the medial surface of each field plate 66Y and 66Y', respectively.

[0020] X follower has the arm 74 of the ****(ed) couple, and 74', and the end section of these arms is being fixed to the crosspiece 76. The actuation truck 78 and the actuation element like 78' (refer to drawing 5) are prepared in an arm 74 and 74', respectively, and are made as [collaborate / with actuation element 42X of an X-Y stage, and 42X']. In the example of a graphic display, since actuation element 42X on an X-Y stage and 42X' are shown as a drive coil, the actuation truck on the X follower 72 has taken the magnetic gestalt. Moreover, a joint element can be reversed, a coil can be prepared on X follower, and a magnet can also be formed on an X-Y stage. In case an X-Y stage drives in X and the direction of Y, laser interferometer equipment 92 detects the new location of an X-Y stage in an instant, and generates positional information (value of an X coordinate). X-Y stage 30 is followed without the positional controller 94 of the servo mold controlled by the host processor (CPU) 96 controlling the location of the X follower 72 and the Y follower 82, and carrying out mechanical association of between drive coil 42X and 42X', and trucks 74 and 74' according to the positional information from interferometer equipment 92, so that it may explain to a detail later with reference to drawing 10 .

[0021] X -- a follower -- 72 -- a reaction -- a frame -- 61 -- motion -- possible -- attaching -- a sake -- a reaction -- a frame -- 61 -- a side -- it is -- an arm -- 74 -- 74 -- ' -- an edge -- a rail -- 69 -- a top -- riding -- showing around -- having -- an arm -- 74 -- 74 -- ' -- an opposite hand -- an edge -- a field -- a plate -- 66 -- Y -- ' -- adjoining -- a rail -- 69 -- ' -- riding -- **** . In order to move the X follower 72, a driving member 77 is formed on a crosspiece 76, collaborates with the reaction frame guide 69, and moves a follower 72 in the direction which intersects perpendicularly to the direction of X of an X-Y stage. Since exact control and actuation are performed by X-Y stage 30, the X follower's 72 point to point control does not need to prepare strict tolerance and a strict air gap in about 30 X-Y stage like an X-Y stage correctly. therefore, a drive 77 can be made into the combination of the combination of the screw shaft which rotates by the motor, and the nut which engages with the X follower 72 or the coil assembly which forms a linear motor, and a magnet assembly, and can combine the combination of each above with a roller guide device further.

[0022] X -- a follower -- 72 -- the same -- Y -- a follower -- 82 -- the -- an end -- the section -- a crosspiece -- 86 -- fixing -- having had -- a couple -- an arm -- 84 -- 84 -- ' -- having -- **** -- these -- an arm -- Y -- a driving member -- 44 -- Y -- 44 -- Y -- ' -- collaborating -- a truck -- 88 -- 88 -- ' -- having -- **** . The Y follower's 82 arm 84 and 84' are guided on a separate guide rail. On the upper rail 67 and 67', the both ends of an arm 84 ride, and are shown, and the both ends of arm 84' are shown on the downward rail 68 and 68'. A drive 87 is formed in the Y follower's 82 crosspiece 86, and moves the Y follower 82 in the direction which intersects perpendicularly in the direction of Y of an X-Y stage along with guide 67, 67' and 68, and 68' between field plate 66Y and 66Y'.

[0023] All of the X follower's 72 arm 74, 74', and crosspiece 76' are arranged in the same flat surface which intersects perpendicularly with Z axis, and they move so that it may be best shown in drawing 9 . The center of gravity of X-Y stage 30 is in the above-mentioned flat surface, or adjoins this flat surface immediately. In this structure, each drive coil 42X and the driving force from 42X' work in an arm 74 and the direction which meets the die length of 74', respectively. However, the Y follower's 82 arm 84 and 84' are mutually ****(ed) along with Z axis, and each is the upper part of a flat surface including the X follower 72, and in a separate parallel flat surface parallel [that it is caudad] to this flat surface, and moves in that flat surface. In a desirable example, a crosspiece 86 is in the flat surface of the lower part containing arm 84', and spacer block 86' is located between the edges where an arm 84 and crosspieces 86 overlap, and it is ****(ing) an arm 84 and 84' at each parallel flat surface. Each drive coil 44Y and the driving force from 44Y' work like the X follower 72 in an arm 84 and the direction which meets the die length of 84'. Moreover, between drive coil 44Y (44Y') and the actuation truck 88 (88'), the predetermined gap was maintained by the direction of X, and the Z direction, and the concept of guide loess is attained.

[0024] In case the guide loess stage of this invention and the reaction frame of a vibration isolation mold operate X-Y stage 30 is positioned in the initial position to a projection lens detected by interferometer equipment 92. X-Y stage 30 actuation -- a truck -- 78 -- 78 -- ' -- 88 -- 88 -- ' -- a configuration -- depending -- actuation -- an element -- from -- a drive coil -- 42 -- X -- 42 -- X -- ' -- 44 -- Y -- 44 -- Y -- ' -- ****(ing) -- having had -- a condition -- pneumatic bearing -- an object -- a stage -- the base -- 28 -- from -- a Z direction -- supporting -- having . There is no contact between X-Y stage 30 and the reaction frame 61. That is, an oscillation of a reaction frame is transmitted and the path which affects the location of an X-Y stage, or the path of the objection does not exist at all. The indirect contact which minds [the means of communication which sends a signal to a coil, and] the location detection equipment of a laser interferometer only exists, and other commands which start the driving signal with which delivery and this control device produce motion of X-Y stage 30 for the positional information which detected the above-mentioned location detection equipment to a controller, i.e., a control device, are received.

[0025] an interferometer -- equipment -- 92 -- from -- an X-Y stage -- a location -- understanding -- if -- a driving signal -- a positional controller -- 94 -- from -- being suitable -- a drive coil -- 42 -- X -- 42 -- X -- ' -- 44 -- Y -- 44 -- Y -- ' -- sending -- having -- an X-Y stage -- the location of a new request -- driving . Motion of an X-Y stage is detected by interferometer equipment 92 and position sensors 98X and 98Y (refer to drawing 10), and the X follower 72 and the Y follower 82 drive by driving members 77 and 87, respectively, and follow an X-Y stage. As shown in drawing 10 , position-sensor 98X detects fluctuation of spacing of the direction of Y between X-Y stage 30 and the X follower 72, and sends the electrical signal showing the value of the spacing to a positional controller 94. A positional controller 94 generates the proper driving signal about a driving member 77 in X location from interferometer equipment 92, and a list based on the signal from position-sensor 98X.

[0026] Moreover, position-sensor 98Y detects fluctuation of spacing of the direction of X between X-Y stage 30 and the Y follower 82, and generates the electrical signal showing the value of the spacing, and a driving member 87 drives it in the information on Y location from interferometer equipment 92, and a list based on the signal from position-sensor 98Y.

[0027] Amendment is performed whenever [yaw angle] by the motor pair which can be used in order to maintain or amend whenever [yaw angle]. That is, the above-mentioned motor pair can change the location of the hand of cut of an X-Y stage. The data from both laser beam 40A/40A', and 40B/40B' are used in order to acquire information whenever [yaw angle]. [both / one side or] Electronic subtraction of the digital location data obtained from the measurement using laser beam 40A, 40A' or 40B, and 40B' is performed, or both difference is added, and it divides by 2.

[0028] This invention makes it possible to perform the positioning function of an X-Y stage more nearly promptly than the case where XY guide is used. The reaction force produced in case an X-Y stage moves is separated from image formation optical system and a reticle processor device.

[0029] Since this invention does not need exact X guide or Y guide at all and does not have a precise guide as compared with the stage guided, actuation of the precise assembly of the X-Y stage of a wafer and accommodation decreases. Since the force of the linear motor in XY axis carries out a direct action to the stage of a wafer, that is, the above-mentioned linear motor does not need to act through guide equipment, the control bandwidth of a servo increases.
[0030] Altogether, the force from XY linear motor can be made to transmit through the center of gravity of an X-Y stage substantially, and, thereby, eliminates the moment of force (torque) which is not desirable.
[0031] the X follower 72 and the Y follower 82 who it has each other perfect independently, and operate -- using -- as magnetic coupling between each followers 72 and 82 and X-Y stages 30 -- commercial -- available electromagnetism -- if a linear motor is used and the gap between a coil and a magnet actuation truck is made smaller than about 1mm, any oscillations of a follower will not be transmitted to the X-Y stage or optical equipment of a wafer. Moreover, the vector sum of the upper part of the arm of the follower of another side and the moment of force in the center of gravity of an X-Y stage if it **** caudad becomes equal to zero substantially according to the positioning force of a driving member of collaborating, about one follower's arm.
[0032] Between an X-Y stage and each follower stage, it could be considered that the connection which approves does not exist at all that an oscillation is transmitted in the degree of freedom of X, Y, or theta among these stages. Thereby, a follower stage can be attached in the vibrating criteria frame, without affecting the engine performance of the stage of a wafer. For example, an X-Y stage and projection optics equipment will not be influenced when a reaction frame hits with an obstruction.
[0033] When a center of gravity is between one of two X drive coils, and one of two Y drive coils and there is in the equal distance, thereby, driving an X-Y stage to a desired location will be understood by this contractor by sending the proper signal with which magnitude differs to each coil, and giving the bigger force to it at a heavier stage side. [no]
[0034] specification -- an application -- receiving -- electromagnetic force -- motion -- being possible -- an X-Y stage -- giving -- a sake -- an actuator -- namely, -- the MAG -- a joint assembly -- actuation -- an element -- 42 -- X -- /-- 42 -- X -- ' -- or -- 42 -- Y -- /-- 42 -- Y -- ' -- X -- a direction -- or -- Y -- a direction -- it can set -- a stage -- motion -- being related -- respectively -- having stood it still -- a condition -- a fixed location -- it can hold (refer to drawing 10) .
[0035] As explanation of the last of this example, the essential structure of this invention is explained again with reference to drawing 4 . As shown in drawing 4 , X-Y stage 30 can exercise in X, Y, and the direction of theta on the stage base 28, without being supported with the flatness of the stage base 28 by the pneumatic bearing 36 which has an air blowdown port and a vacuum precompression port on the smooth front face (it being parallel to a X-Y flat surface), and receiving friction in any way by it.
[0036] The stage base 28 is supported on the foundation (or a ground surface or base structure) with the vibration isolation block 20, the arm 18, the block 22, the vertical bar 26, and the level bar 27. Each vibration isolation block 20 is equipped with the oscillating absorption assembly which prevents transfer of the oscillation from a foundation 21.
[0037] Since drawing 4 is a sectional view of X-Y stage 30 which meets the line which passes along drive coil 42X and 42X' in the direction of Y, the following explanation is limited to the X follower 72. drawing 4 -- setting -- a drive coil -- 42 -- X -- a follower -- an arm -- 74 -- equipping -- having had -- actuation -- a truck (train of a magnet long and slender in the direction of X) -- 78 -- a magnetic field -- inside -- preparing -- having -- **** -- a drive coil -- 42 -- X -- ' -- a follower -- an arm -- 74 -- ' -- equipping -- having had -- actuation -- a truck -- 78 -- ' -- a magnetic field -- inside -- preparing -- having -- **** .
[0038] Two arms 74 and 74' are strongly assembled by the guide rail 69 and 69' which were formed inside the reaction frame 61 so that it may move in the direction of Y together. Moreover, a guide rail 69 and 69' restrict X of two arms 74 and 74', and motion of a Z direction. The reaction frame 61 is independently supported directly on the foundation 21 in the stage base 28 in four support posts 62.
[0039] Therefore, drive coil 42X (42X') and the actuation truck 78 (78') are arranged by each so that a predetermined gap (several mm) may be maintained in Y and a Z direction. Therefore, if drive coil 42X and 42X' drives and X-Y stage 30 is moved in the direction of X, the actuation truck 78 and the reaction force produced in 78' will be transmitted to a foundation 21, and will not be transmitted to X-Y stage 30.
[0040] On the other hand, when X-Y stage 30 moves in the direction of Y, two arms 74 and 74' follow each actuation truck 78 and 78' by this by moving in the direction of Y by the driving member 77 at each coil 42X and 42X' based on the measurement signal of position-sensor 98X, and the gap of the direction of Y is maintained.

[0041] Although this invention was explained to the list with reference to the driving member of a couple, i.e., coil 42X, 42X', and a desirable example equipped with driving member of couple, i.e., coil 44Y, and 44Y', it can constitute a vibration isolation reaction frame and a guide loess stage according to **** shown in drawing 11 and drawing 12 , and this invention which has three driving members, i.e., a linear motor, exactly. As shown in drawing 11 , Y drive coil 144Y of a couple and 144Y' are prepared in a stage 130, and it is prepared according to center-of-gravity CG' of an X-Y stage, single X drive coil, i.e., linear motor 142X. Y drive coil 144Y and 144Y' is prepared in the Y follower's 182 arm 184, and 184', and X drive coil 144X is prepared in the X follower's 172 arm 174." An X-Y stage can be moved to desired XY location by giving a proper driving signal to drive coils 142X and 144Y and 144Y'.
[0042] next -- drawing 13 -- or -- drawing 16 -- referring to -- if -- this invention -- being another -- an example -- being shown -- having -- **** -- this -- an example -- XY -- a drive coil -- 242 -- X -- 242 -- X -- ' -- 244 -- Y -- 244 -- Y -- ' -- an X-Y stage -- 30 -- ' -- mounting -- the section -- between -- a link -- having -- **** . These bond parts are equipped with the double flat spring assembly 300 which combines drive coil 244Y with the end section of the bond part material 320, and the double flat spring assembly 320 which combines the other end of the bond part material 320 with X-Y stage 30'. The double flat spring assembly 300 has the flange 302 fixed to coil 244Y. Through the clamp bolt, the clamp member 304 is attached in the flange 302, and has faced across one edge of the level flexible link 306 between them. These level members are fixed to a vertical flange 310 and vertical one in order by pinching the other end of the flexible link 306 between two level members 308, the bolt stop of the flange material 312 of a couple is carried out to this vertical flange, and the flange material of this couple has faced across one edge of the vertical flexible member 314. It faces across the edge of vertical another side of the flexible member 314 between the flange material 316 of a couple, and the bolt stop of the flange material of this couple is carried out to the flange plate 318 of the end section of a holddown member 320 at order. In the other end of a holddown member 320, the plate 348 is being fixed to two flange material 36, and the bolt stop of these two flange material is mutually carried out so that the end section of the vertical flexible member 344 may be inserted. the flange material 342 faces across the edge of the vertical opposite hand of a member 344, and these flange material is fixed to the plate 340 fixed to the clamp plate 338 of the couple which faces across one edge of the level flexible member 336 in order -- having -- **** -- the above -- the edge of the level opposite hand of a flexible member is inserted into X-Y stage 30' in response to the assistance of a plate 334. Therefore, in each double flat spring assemblies 300 and 330, an oscillation decreases by [level] reaching and preparing both vertical flexible members. in the assembly of these each, a vertical flexible member decreases the oscillation of X, Y, and theta, and a level flexible member decreases the oscillation of Z, dip, and the sideslip direction. Therefore, eight horizontal deflection fasteners about Z, dip, and the sideslip direction are formed in the deflection fastener of eight perpendicular directions about X, Y, and theta, and a list.
[0043] As shown in drawing 16 , coil 244Y is attached in coil support 245Y, this coil support has the upper support plate 246 attached in this, and this upper support plate has ridden on the crowning of the magnetic-track assembly 288. The pneumatic bearing 290 of a vacuum precompression mold is formed between the magnetic-track assemblies 288 as another side with coil support 245Y and the upper support plate 246 as one side again. In the example of actuation of the example shown in drawing 13 thru/or drawing 16 , for width of face, about 31.8 mm (1 1 / 4 inches) and die length are [about 6.4mm (1/4 inch) and thickness] 0.305mm (0.012 inches) stainless steel, and the direction of a primary deflection of the flexible members 306, 314, 344, and 336 is the direction of thickness. In the example of a graphic display, members 306 and 314 are in a direct crossover **** condition mutually about each direction of a primary deflection, and are arranged by the serial, and members 344 and 336 are arranged similarly.
[0044] Although this invention was explained about the desirable example, this invention can take the gestalt from which many differ, and the range of this invention is limited by only the claim.

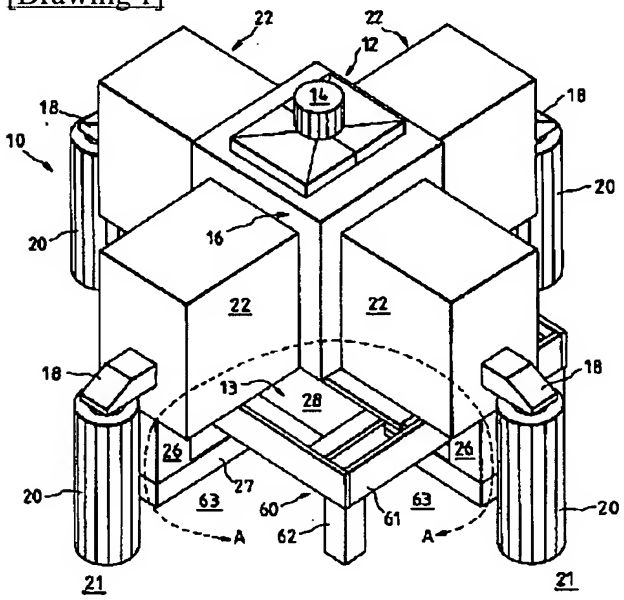
[Translation done.]

* NOTICES *

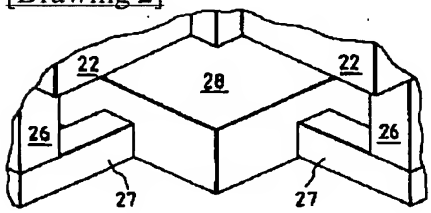
1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

DRAWINGS

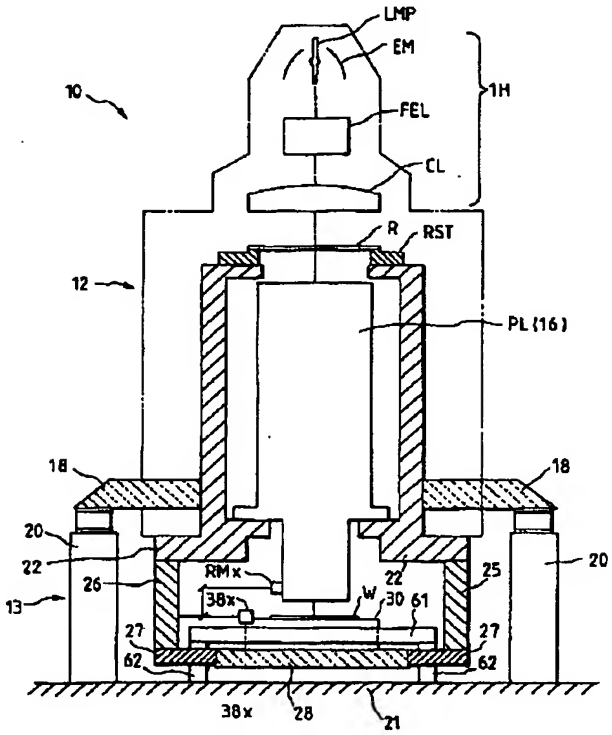
[Drawing 1]



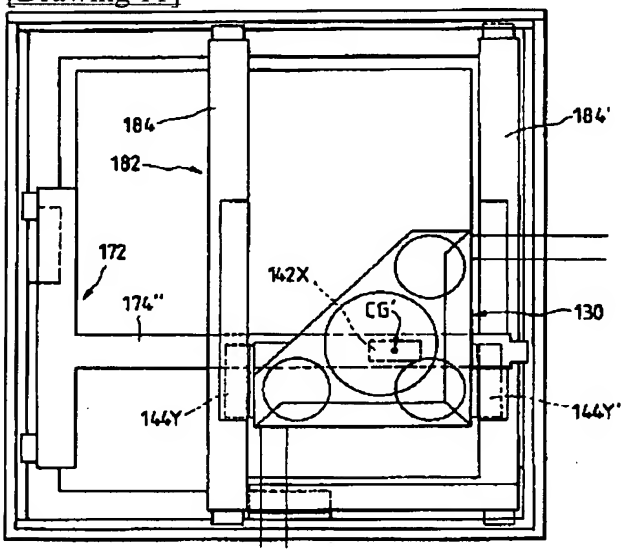
[Drawing 2]



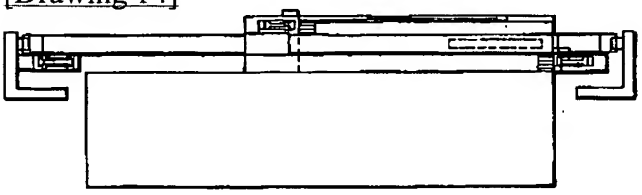
[Drawing 3]



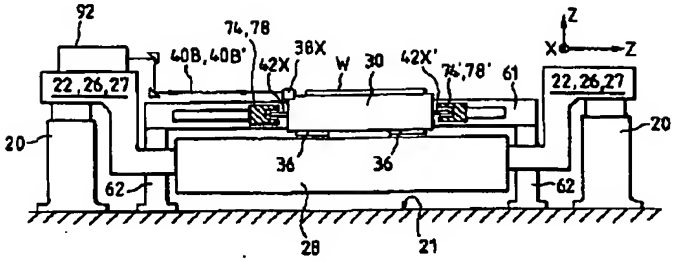
[Drawing 11]



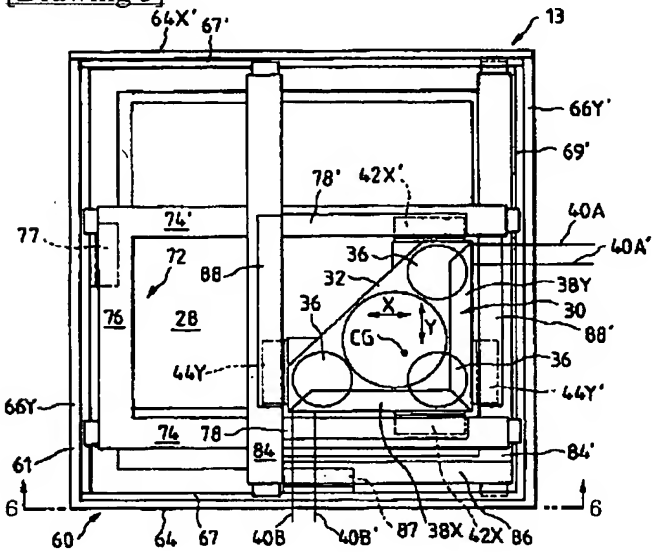
[Drawing 14]



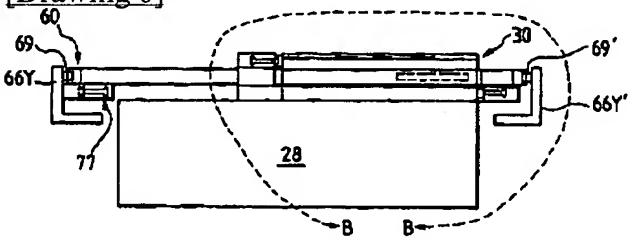
[Drawing 4]



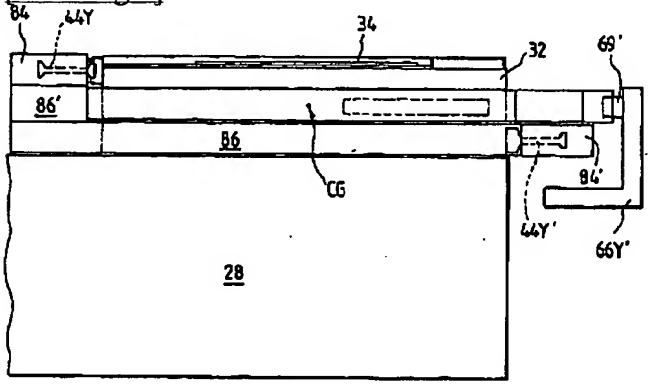
[Drawing 5]



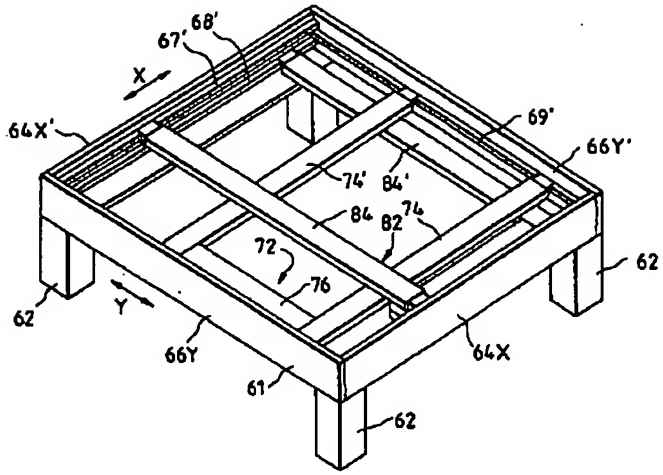
[Drawing 6]



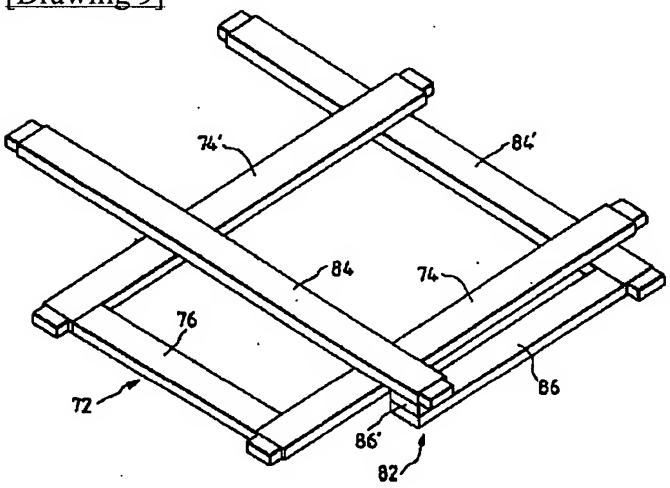
[Drawing 7]



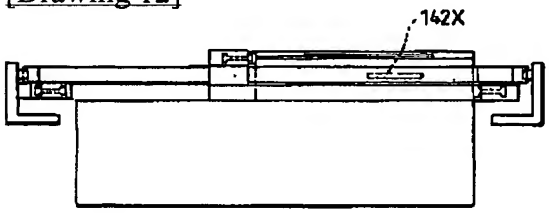
[Drawing 8]



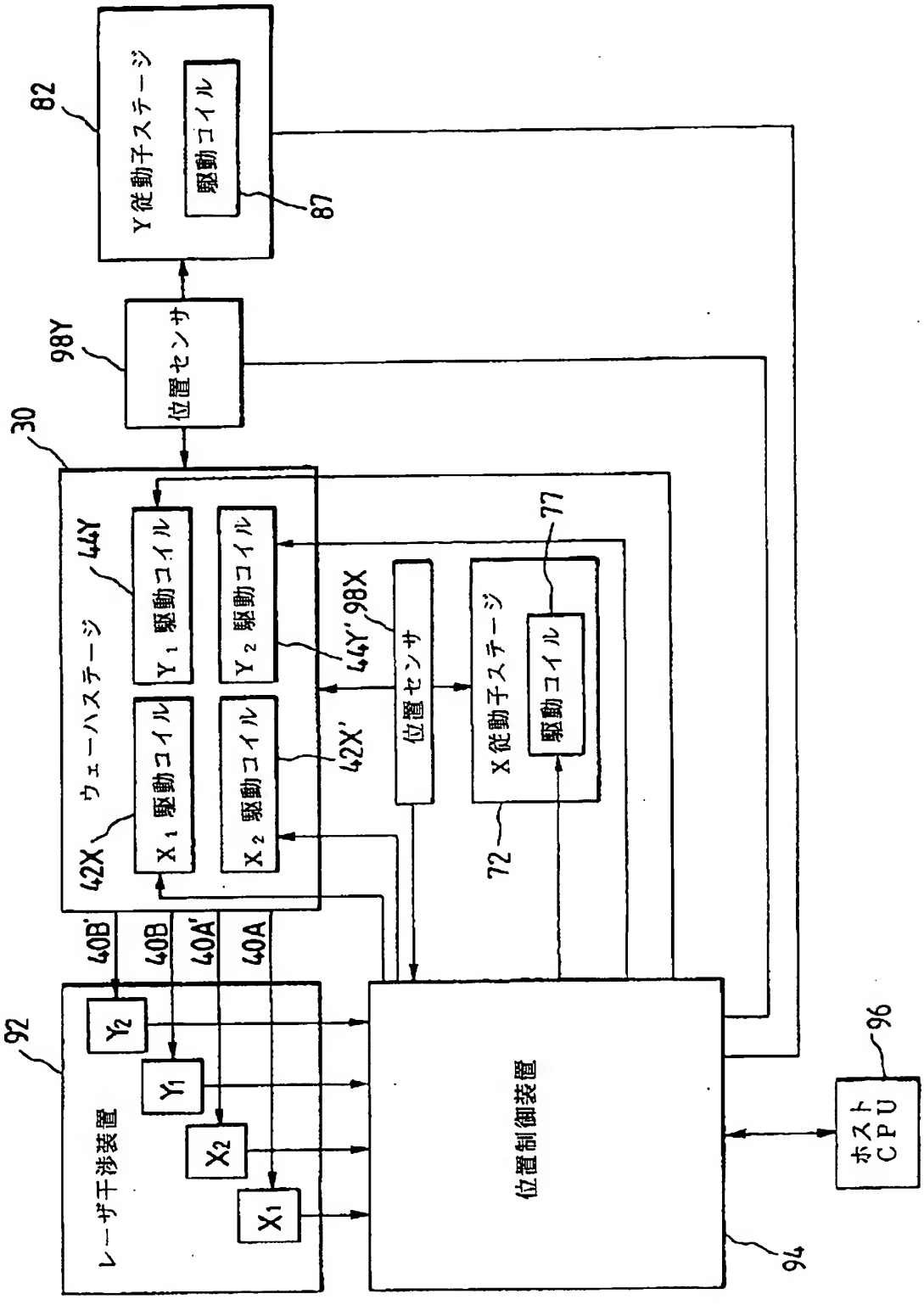
[Drawing 9]



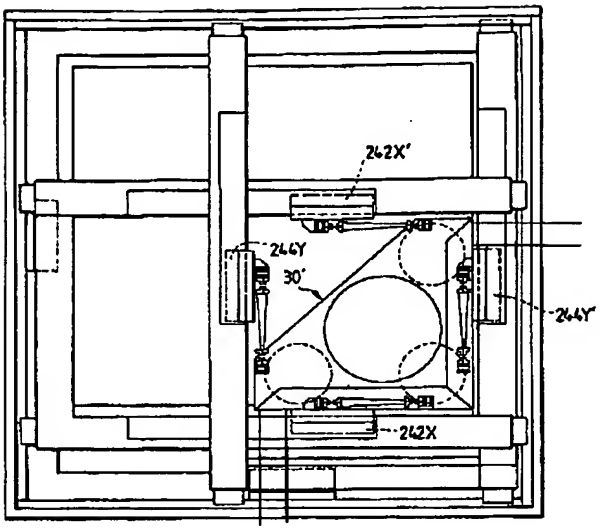
[Drawing 12]



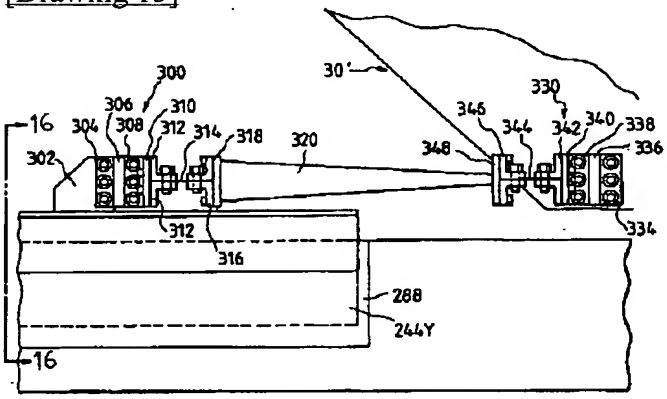
[Drawing 10]


82
Y従動子ステージ
駆動コイル
87
98Y
位置センサ
30
44Y
ウェーハステージ
Y1 駆動コイル
Y2 駆動コイル
42X
X1 駆動コイル
X2 駆動コイル
42X'
44Y'
98X
位置センサ
77
X従動子ステージ
駆動コイル
72
40B'
40B
40A'
40A
92
Y2
Y1
X2
X1
レーザ干渉装置
位置制御装置
96
ホスト
CPU
94

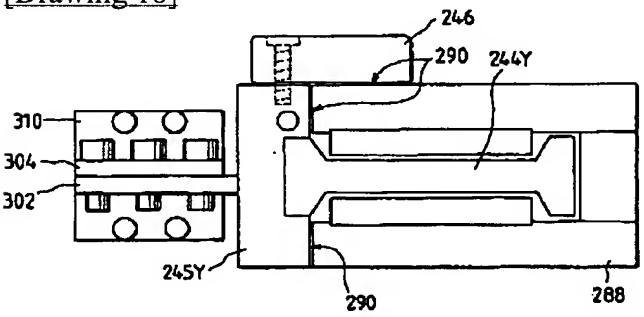
[Drawing 13]



[Drawing 15]



[Drawing 16]



[Translation done.]

* NOTICES *

CORRECTION OR AMENDMENT

[Kind of official gazette] Printing of amendment by the convention of 2 of Article 17 of Patent Law
[Category partition] The 1st partition of the 6th category
[Publication date] November 8, Heisei 14 (2002. 11.8)

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[Date of Publication] June 25, Heisei 8 (1996. 6.25)
[Annual volume number] Open patent official report 8-1665
[Application number] Japanese Patent Application No. 7-75223
[The 7th edition of International Patent Classification]

G12B 5/00
H01L 21/68

[FI]

G12B 5/00 T
H01L 21/68 G

[Procedure amendment]
[Filing Date] August 13, Heisei 14 (2002. 8.13)
[Procedure amendment 1]
[Document to be Amended] Description
[Item(s) to be Amended] Claim
[Method of Amendment] Modification
[Proposed Amendment]
[Claim(s)]
[Claim 1] In the pointing device which operates on base structure,
(a) The reaction frame assembly containing the reaction frame attached in said base structure,
(b) The object stage which exercises relatively to the base of an object stage,
(c) The means for setting spacing from the base of said object stage, and supporting said object stage independently, with said reaction frame,
(d) It is attached in said object stage and said reaction frame assembly, and it becomes a couple for positioning said object stage, collaborates, and has the actuator means of the direct-acting mold which generates the force,
The pointing device which the base of said object stage and said object stage are insulated from the reaction force from said actuator means, and is characterized by transfer of the oscillation to the base of said object stage and said object stage serving as min by this.
[Claim 2] The positioning device with which said reaction frame assembly is characterized by having the follower who can exercise for said object stage independently and can follow it in the positioning device of claim 1.
[Claim 3] The positioning device characterized by equipping said actuator means with at least one linear motor which operates between said object stage and said reaction frame assembly in the positioning device of claim 1.
[Claim 4] the positioning device with which it has the actuator means of a lot at least in the positioning device of claim 1 in order to position said object stage, and the actuator means of these each is characterized

by having the driving member attached in said object stage.
[Claim 5] The positioning device with which the vector sum of the moment of force in the center of gravity of said object stage resulting from the positioning force of said driving member is characterized by being substantially equal to zero in the positioning device of claim 4.
[Claim 6] The positioning device characterized by having at least one driving member attached in said object stage in the positioning device of claim 2.
[Claim 7] The pointing device characterized by for said follower having two arms which can exercise, respectively in two parallel flat surfaces, and the center of gravity of said object stage being between said two flat surfaces in the pointing device of claim 2.
[Claim 8] In the positioning device of claim 1 said object stage In the 1st direction, and this 1st direction and the 2nd direction which makes an include angle, it can exercise at least. The 1st follower is movable only in said 1st direction, and follows said object stage. The 2nd follower is movable only in said 2nd direction, and follows said object stage. Moreover, said actuator means to collaborate The pointing device characterized by being prepared for said object stage and said 1st and 2nd followers, and positioning said object stage in said 1st and 2nd directions.
[Claim 9] It is the positioning device characterized by having the direct-acting mold actuator which generates at least three force in which said actuator means operates between said object stage and said reaction frame assembly in the positioning device of claim 8.
[Claim 10] The positioning device with which it is prepared and the vector sum of the moment of force in the center of gravity of said object stage resulting from the positioning force of an actuator means to collaborate is characterized by being substantially equal to zero in the positioning device of claim 9 as said object stage driven in said 1st direction in two of said at least three direct-acting mold actuators.
[Claim 11] The positioning device with which the vector sum of the moment of force in the center of gravity of said object stage where one of said the direct-acting mold actuators other than said two direct-acting mold actuators is attached in said object stage, and it originates in the positioning force of said actuator means to collaborate, in the positioning device of claim 10 so that said object stage may be driven in said 2nd direction is characterized by being substantially equal to zero.
[Claim 12] In the positioning device of claim 8, it has at least 2 sets of direct-acting mold actuators for positioning said object stage. 1 set in these direct-acting mold actuator 1 set which will position said object stage in said 1st direction, and will accept it among said direct-acting mold actuators The pointing device with which the vector sum of the moment of force in the center of gravity of an X-Y stage which positions said object stage in said 2nd direction, and originates in the positioning force of an actuator means to these-collaborate is characterized by being substantially equal to zero.
[Claim 13] It is the pointing device which said 1st and 2nd followers have two arms ****(ed) respectively in the pointing device of claim 8, one follower's arm is located in a single flat surface, and can exercise, and is characterized by locating the arm of the follower of another side in two parallel flat surfaces in which said single flat surface is located between them, and being able to exercise.
[Claim 14] The positioning device with which the center of gravity of said object stage is characterized by being adjacently located in the inside of said single flat surface, or the flat surface of this single in the positioning device of claim 13.
[Claim 15] In a pointing device,
(a) The object stage which exercises at least in the 2nd direction which makes an include angle in the 1st direction and this 1st direction,
(b) With the 1st follower who is movable only in said 1st direction and follows said object stage
(c) With the 2nd follower who is movable only in said 2nd direction and follows said object stage
(d) The pointing device characterized by having a force actuator means of a direct-acting mold to collaborate for being attached in said object stage and a list at said 1st and 2nd followers, and positioning said object stage in said 1st and 2nd directions.
[Claim 16] It is the positioning device characterized by having at least three direct-acting type force actuators with which said actuator means operates among said object stage and said each follower in the positioning device of claim 15.
[Claim 17] The positioning device with which it is prepared and the vector sum of the moment of force in the center of gravity of said object stage resulting from the positioning force of an actuator means to collaborate is characterized by being substantially equal to zero in the positioning device of claim 16 as said object stage driven in said 1st direction in two of said at least three direct-acting mold actuators.
[Claim 18] The positioning device with which the vector sum of the moment of force in the center of gravity

of said object stage where one of said the direct-acting mold actuators other than said two direct-acting mold actuators is attached in said object stage, and it originates in the positioning force of said actuator means to collaborate, in the positioning device of claim 17 so that said object stage may be driven in said 2nd direction is characterized by being substantially equal to zero.
[Claim 19] In the positioning device of claim 15, it has at least 2 sets of direct-acting mold actuators for positioning said object stage. 1 set in these direct-acting mold actuator Said object stage is positioned in said 1st direction. Another side of said direct-acting mold actuators The pointing device with which the vector sum of the moment of force in the center of gravity of an object stage which positions said object stage in said 2nd direction, and originates in the location force of an actuator means to these-collaborate is characterized by being substantially equal to zero.
[Claim 20] It is the pointing device which said 1st and 2nd followers have two arms ****(ed) respectively in the pointing device of claim 15, one follower's arm is located in a single flat surface, and can exercise, and is characterized by locating the arm of the follower of another side in two parallel flat surfaces in which said single flat surface is located between them, and being able to exercise.
[Claim 21] It is the pointing device with which the vector sum of the moment of force in the center of gravity of said object stage which originates in the positioning force of a driving member of said follower having at least one driving member in each, and collaborating, in the pointing device of claim 20 is characterized by being substantially equal to zero.
[Claim 22] The positioning device with which the center of gravity of said object stage is characterized by being adjacently located in the inside of said single flat surface, or the flat surface of this single in the positioning device of claim 20.
[Claim 23] The pointing device of claim 15 characterized by being constituted so that it may have the following, and it may insulate from the oscillation which the base of said object stage and said object stage produce according to each reaction force by this, therefore the oscillation of the base of said object stage and said object stage may become min. The base of an object stage The reaction frame assembly which has the reaction frame prepared in base structure The means for supporting said each follower from said reaction frame assembly The means for setting spacing and supporting said object stage from the base of said object stage, independently, with said reaction frame
[Claim 24] In alignment equipment,
(a) The X-Y stage which has a center of gravity,
(b) The means for setting said X-Y stage from the base of an X-Y stage, and supporting spacing,
(c) It has the reaction frame assembly which has the reaction frame which became independent of the base of said X-Y stage, and which was supported on the base of a reaction frame,
(d) said X follower who said reaction frame assembly has X follower and Y follower who can exercise independently who can exercise independently, and was attached in said reaction frame possible [motion] -- the direction of X -- motion -- possible -- moreover, said reaction frame -- motion -- possible -- an installation ****** Y follower -- the direction of Y -- motion -- possible
(e) Either said X follower or Y follower has at least two ****(ed) arms, and another side of said X follower and Y follower has at least one arm,
The alignment equipment concerned is ,
(f) It is prepared by the relation ****(ed) among said X-Y stage and said each follower, and has a direct-acting mold actuator means for the couple for positioning said X-Y stage horizontally to collaborate, and to generate the force,
(g) Said actuator means is equipped with the actuator part element means formed in the arm of said follower of each, and an actuation primary-member means for it to be prepared in said X-Y stage to it, to collaborate with said actuator part element means, and to position said X-Y stage,
The base of said X-Y stage and said X-Y stage are alignment equipment which is insulated from the oscillation produced according to reaction force, and is characterized by being constituted so that the base of said X-Y stage and the oscillation of said X-Y stage may become min by this.
[Claim 25] In the alignment equipment of claim 24, said one arm prepared for either said X follower or the Y followers Two arms which are arms of said couple which could exercise in the single flat surface and was prepared in another side of said X follower and Y follower Alignment equipment characterized by locating in two independent flat surfaces in which said single flat surface is located between them, respectively, and being able to exercise in this flat surface.
[Claim 26] Alignment equipment with which the vector sum of the moment of force in the center of gravity of said X-Y stage which has said actuator part element means formed in the arm of said couple of said one

follower in the alignment equipment of claim 25, is equipped with the means for controlling it, and originates in the positioning force of an actuation primary-member means to collaborate is characterized by being substantially equal to zero.
[Claim 27] In the approach for positioning an object,
(a) The process which positions a reaction frame on the base,
(b) The process which supports an object on an object stage,
(c) The process which supports said object stage for said object on space in a certain location from the base of an object stage independently with said reaction frame,
(d) The positioning approach characterized by applying the force between said object stages and said reaction frames, driving said object stage in the new location of at least one direction of [on space], and having simultaneously the process which insulates the base of said object stage from the reaction force produced by applying said force.
[Claim 28] In the approach of positioning an object stage to space by moving in the 1st direction and 2nd direction by the 1st follower and 2nd follower at least,
(a) The process which supports said object stage to space,
(b) between said object stage and said 1st follower -- the force -- in addition, the process which drives said object stage only in said 1st direction,
(c) between said object stage and said 2nd follower -- the force -- in addition, the process which drives said object stage only in said 2nd direction,
(d) The process which drives said 1st follower and is made to follow said object stage independently with said 2nd follower only in said 2nd direction,
(e) The positioning approach of the object characterized by driving said 2nd follower and having independently the process made to follow said object stage with said first follower only in said 1st direction.

[Claim 29] The positioning device with which it has a means to attach said actuator means between said object stages and said reaction frames, in the positioning device of claim 1, and this installation is characterized by the strong thing in the direction of driving force at least.
[Claim 30] The positioning device with which it has a means to attach said actuator means among said object stage and said each follower, in the positioning device of claim 15, and this installation is characterized by the strong thing in said direction of driving force at least.
[Claim 31] The positioning device with which it has in the positioning device of claim 24 with a means to attach said actuator means among said X-Y stage and said each follower, and this installation is characterized by the strong thing in said direction of driving force at least.
[Claim 32] the base plate which has a flat surface -- this -- the precision pointing device which has the stage which can exercise along a predetermined direction in a flat surface top -- setting
(a) The 1st support assembly for supporting said base plate on a foundation,
(b) It has an actuator assembly for giving electromagnetic force to the stage in which said motion is possible along said predetermined direction, and this actuator assembly,
(i) the passive-movement section which is attached in the stage in which said motion is possible, and can exercise in said predetermined direction and which can be exercised -- and
(ii) The actuator located in the perimeter of the stage in which said motion is possible is provided,
(iii) Either said passive-movement section or said actuator has a coil unit, and another side of said passive-movement section and said actuator has the magnetic unit,
Further,
(c) The precision pointing device characterized by having the 2nd support assembly which supports said actuator on said foundation independently with said 1st support assembly, and forms a predetermined gap between said coil units and said magnetic units by this.
[Claim 33] The precision positioning device characterized by being held in the precision positioning device of claim 32 in the location where said actuator of said actuator assembly stood it still to said predetermined direction.
[Claim 34] In the pointing device of claim 1,
The pointing device characterized by having an interferometer means to detect the location of said object stage.
[Claim 35] In the pointing device of claim 1,
The pointing device characterized by having the support means which supports the base of said object stage independently with said reaction frame.

[Claim 36] In the pointing device of claim 35,
The pointing device characterized by having an interferometer means to detect the location of said object stage.
[Claim 37] In the pointing device of claim 36,
Said interferometer means is a pointing device characterized by having Miller prepared in said object stage, and interferometer equipment formed in said support means which supports the base of said object stage.
[Claim 38] In the pointing device of claim 2,
The pointing device characterized by having the position sensor which detects spacing of said object stage and said follower.

[Translation done.]

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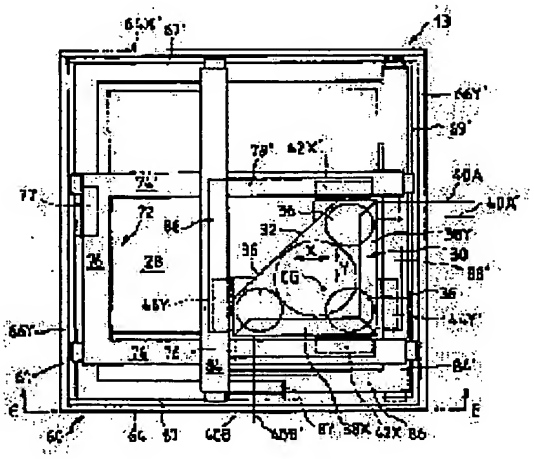
(54) POSITIONING DEVICE, ALIGNMENT DEVICE AND POSITIONING METHOD

(57)Abstract:
PURPOSE: To support an object and control the positioning so that the reaction force and the vibration caused by the motion of the object do not propagate to such an element as lens system.
CONSTITUTION: A reaction frame 61 insulating the external vibration and that caused by the reaction force from an object stage 30 is provided. The object stage 30 moves in two directions. The reaction frame is provided by two followers. Cooperating direct drive force actuators are provided on the object stage and the followers and the object stage is positioned in the first and the second directions. The reaction frame is fixed to a base structure and the object stage is supported in the space independently of the reaction frame. The follower 72 has a pair of arms 74, 74' and moves in a pair of parallel planes wherein the center of gravity of the object stage. The positioning force of actuator driving means is controlled so that the vector sum of the moments of forces at the gravity center of the object stage becomes practically zero.



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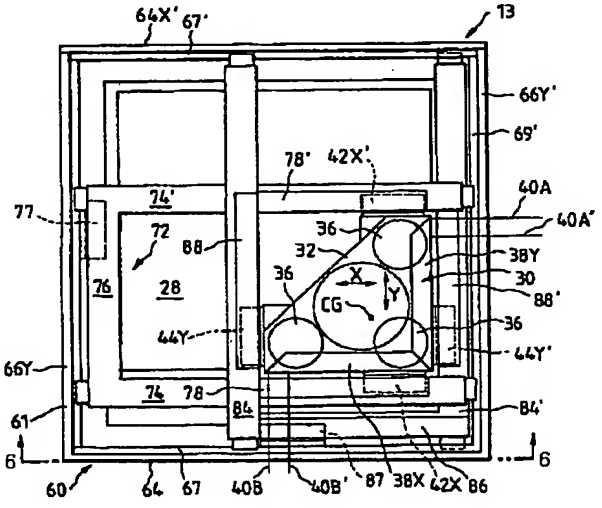
(54)【発明の名称】　位置決め装置、アライメント装置、及び、位置決め方法

(57)【要約】　（修正有）

【目的】対象物の運動により生ずる反力及び振動が、レンズ系の如き他の要素に伝達しないように、対象物を支持、位置決め、及び、制御する。

【構成】外部振動、及び、対象物ステージ３０からの反力によって生ずる振動を絶縁する反作用フレーム６１を備える。対象物ステージは２つの方向に運動する。反作用フレームは、２つの従動子を備える。協働する直動型の力アクチュエータが、対象物ステージ及び従動子にに設けられ、対象物ステージを第１及び第２の方向において位置決めする。反作用フレームは、ベース構造に取り付けられ、対象物ステージは、反作用フレームと独立して空間に支持される。従動子７２は、一対のアーム７４、７４'を有し、対象物ステージの重心がある一対の平行な平面の中で運動する。アクチュエータ駆動手段の位置決め力は、対象物ステージの重心における力のモーメントのベクトル和が、実質的にゼロになるように制御される。



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【特許請求の範囲】

【請求項１】　ベース構造上で作動する位置決め装置において、

（ａ）　前記ベース構造に取り付けられた反作用フレームを含む反作用フレームアセンブリと、

（ｂ）　対象物ステージのベースに対して相対的に運動する対象物ステージと、

（ｃ）　前記反作用フレームとは独立して前記対象物ステージを前記対象物ステージのベースから間隔をおいて支持するための手段と、

（ｄ）　前記対象物ステージ及び前記反作用フレームアセンブリに取り付けられ、前記対象物ステージを位置決めするための一対になって協働し、力を発生する直動型のアクチュエータ手段とを備え、

前記対象物ステージのベース及び前記対象物ステージが、前記アクチュエータ手段からの反力から絶縁され、これにより、前記対象物ステージのベース及び前記対象物ステージへの振動の伝達が最小となることを特徴とする位置決め装置。

【請求項２】　請求項１の位置決め装置において、前記反作用フレームアセンブリが、前記対象物ステージに独立して運動して追従することのできる従動子を備えることを特徴とする位置決め装置。

【請求項３】　請求項１の位置決め装置において、前記アクチュエータ手段が、前記対象物ステージと前記反作用フレームアセンブリとの間で作動する、少なくとも１つのリニアモータを備えることを特徴とする位置決め装置。

【請求項４】　請求項１の位置決め装置において、前記対象物ステージを位置決めするための少なくとも一組のアクチュエータ手段を備え、これら各々のアクチュエータ手段が、前記対象物ステージに取り付けられた駆動部材を有することを特徴とする位置決め装置。

【請求項５】　請求項４の位置決め装置において、前記駆動部材の位置決め力に起因する、前記対象物ステージの重心における力のモーメントのベクトル和が、実質的にゼロに等しいことを特徴とする位置決め装置。

【請求項６】　請求項２の位置決め装置において、前記対象物ステージに取り付けられた少なくとも１つの駆動部材を備えることを特徴とする位置決め装置。

【請求項７】　請求項２の位置決め装置において、前記従動子が、２つの平行な平面の中でそれぞれ運動可能な２つのアームを備えており、前記２つの平面の間に、前記対象物ステージの重心があることを特徴とする位置決め装置。

【請求項８】　請求項１の位置決め装置において、前記対象物ステージは、第１の方向、及び、該第１の方向と角度をなす第２の方向において少なくとも運動可能であり、第１の従動子が、前記第１の方向においてのみ可動であり、前記対象物ステージに追従し、また、第２の従動子が、前記第２の方向においてのみ可動であり、前記対象物ステージに追従し、前記協働するアクチュエータ手段は、前記対象物ステージ及び前記第１及び第２の従動子に設けられ、前記対象物ステージを前記第１及び第２の方向において位置決めすることを特徴とする位置決め装置。

【請求項９】　請求項８の位置決め装置において、前記アクチュエータ手段は、前記対象物ステージと前記反作用フレームアセンブリとの間で作動する、少なくとも３つの力を発生する直動型アクチュエータを備えることを特徴とする位置決め装置。

【請求項１０】　請求項９の位置決め装置において、前記少なくとも３つの直動型アクチュエータのうちの２つが、前記第１の方向に前記対象物ステージを駆動するように設けられ、協働するアクチュエータ手段の位置決め力に起因する、前記対象物ステージの重心における力のモーメントのベクトル和が、実質的にゼロに等しいことを特徴とする位置決め装置。

【請求項１１】　請求項１０の位置決め装置において、前記２つの直動型アクチュエータ以外の前記直動型アクチュエータの１つが、前記対象物ステージを前記第２の方向に駆動するように、前記対象物ステージに取り付けられ、前記協働するアクチュエータ手段の位置決め力に起因する、前記対象物ステージの重心における力のモーメントのベクトル和が、実質的にゼロに等しいことを特徴とする位置決め装置。

【請求項１２】　請求項８の位置決め装置において、前記対象物ステージを位置決めするための少なくとも２組の直動型アクチュエータを備え、これら直動型アクチュエータのうちの１組は、前記対象物ステージを前記第１の方向において位置決めし、前記直動型アクチュエータのうちのもう１組は、前記対象物ステージを前記第２の方向において位置決めし、これら協働するアクチュエータ手段の位置め力に起因する、ＸＹステージの重心における力のモーメントのベクトル和が、実質的にゼロに等しいことを特徴とする位置決め装置。

【請求項１３】　請求項８の位置決め装置において、前記第１及び第２の従動子は各々、隔置された２つのアームを有しており、一方の従動子のアームは、単一の平面の中に位置して運動可能であり、また、他方の従動子のアームは、前記単一の平面がその間に位置する２つの平行な平面の中に位置して運動可能であることを特徴とする位置決め装置。

【請求項１４】　請求項１３の位置決め装置において、前記対象物ステージの重心が、前記単一の平面の中に、あるいは、該単一の平面に隣接して位置することを特徴とする位置決め装置。

【請求項１５】　位置決め装置において、

（ａ）　第１の方向、及び、該第１の方向に角度をなす第２の方向において、少なくとも運動する対象物ステー

ジと、
（ｂ）　前記第１の方向においてのみ可動であり、前記対象物ステージに追従する第１の従動子と、
（ｃ）　前記第２の方向においてのみ可動であり、前記対象物ステージに追従する第２の従動子と、
（ｄ）　前記対象物ステージ、並びに、前記第１及び第２の従動子に取り付けられ、前記対象物ステージを前記第１及び第２の方向において位置決めするための、協働する直動型の力アクチュエータ手段とを備えることを特徴とする位置決め装置。
【請求項１６】　請求項１５の位置決め装置において、前記アクチュエータ手段は前記対象物ステージと前記各従動子との間で作動する、少なくとも３つの直動型力アクチュエータを備えることを特徴とする位置決め装置。
【請求項１７】　請求項１６の位置決め装置において、前記少なくとも３つの直動型アクチュエータのうちの２つが、前記第１の方向に前記対象物ステージを駆動するように設けられ、協働するアクチュエータ手段の位置決め力に起因する、前記対象物ステージの重心における力のモーメントのベクトル和が、実質的にゼロに等しいことを特徴とする位置決め装置。
【請求項１８】　請求項１７の位置決め装置において、前記２つの直動型アクチュエータ以外の前記直動型アクチュエータの１つが、前記対象物ステージを前記第２の方向に駆動するように、前記対象物ステージに取り付けられ、前記協働するアクチュエータ手段の位置決め力に起因する、前記対象物ステージの重心における力のモーメントのベクトル和が、実質的にゼロに等しいことを特徴とする位置決め装置。
【請求項１９】　請求項１５の位置決め装置において、前記対象物ステージを位置決めするための少なくとも２組の直動型アクチュエータを備え、これら直動型アクチュエータのうちの１組は、前記対象物ステージを前記第１の方向において位置決めし、前記直動型アクチュエータのうちのもう一方は、前記対象物ステージを前記第２の方向において位置決めし、これら協働するアクチュエータ手段の位置め力に起因する、対象物ステージの重心における力のモーメントのベクトル和が、実質的にゼロに等しいことを特徴とする位置決め装置。
【請求項２０】　請求項１５の位置決め装置において、前記第１及び第２の従動子は各々、隔置された２つのアームを有しており、一方の従動子のアームは、単一の平面の中に位置して運動可能であり、また、他方の従動子のアームは、前記単一の平面がその間に位置する２つの平行な平面の中に位置して運動可能であることを特徴とする位置決め装置。
【請求項２１】　請求項２０の位置決め装置において、前記各々の従動子は、少なくとも１つの駆動部材を有しており、協働する駆動部材の位置決め力に起因する、前記対象物ステージの重心における力のモーメントのベクトル和が、実質的にゼロに等しいことを特徴とする位置決め装置。

【請求項２２】　請求項２０の位置決め装置において、前記対象物ステージの重心が、前記単一の平面の中に、あるいは、該単一の平面に隣接して位置することを特徴とする位置決め装置。
【請求項２３】　請求項１５の位置決め装置において、対象物ステージのベースと、ベース構造に設けられた反作用フレームを有する反作用フレームアセンブリと、前記各従動子を前記反作用フレームアセンブリから支持するための手段と、前記反作用フレームとは独立して前記対象物ステージを、前記対象物ステージのベースから間隔をおいて、支持するための手段とを備え、これにより、前記対象物ステージのベース及び前記対象物ステージが、それぞれの反力により生ずる振動から絶縁され、従って、前記対象物ステージのベース及び前記対象物ステージの振動が、最小になるように構成されたことを特徴とする位置決め装置。
【請求項２４】　アライメント装置において、
（ａ）　重心を有するＸＹステージと、
（ｂ）　前記ＸＹステージをＸＹステージのベースから間隔をおいて支持するための手段と、
（ｃ）　前記ＸＹステージのベースとは独立した、反作用フレームのベース上に支持された反作用フレームを有する反作用フレームアセンブリとを備え、
（ｄ）　前記反作用フレームアセンブリは、独立して運動可能なＸ従動子及び独立して運動可能なＹ従動子を有しており、前記反作用フレームに運動可能に取り付けられた前記Ｘ従動子は、Ｘ方向に運動可能であり、また、前記反作用フレームに運動可能に取り付けられた前記Ｙ従動子は、Ｙ方向に運動可能であり、
（ｅ）　前記Ｘ従動子及びＹ従動子の一方は、少なくとも２つの隔置されたアームを有し、前記Ｘ従動子及びＹ従動子の他方は、少なくとも１つのアームを有しており、
当該アライメント装置は更に、
（ｆ）　前記ＸＹステージと前記各従動子の間に隔置された関係で設けられ、前記ＸＹステージを水平方向に位置決めするための一対の協働し力を発生する直動型アクチュエータ手段を備え、
（ｇ）　前記アクチュエータ手段は、前記各々の従動子のアームに設けられた駆動部分要素手段と、それに対して前記ＸＹステージに設けられ、前記駆動部分要素手段と協働して前記ＸＹステージを位置決めする、駆動主要部材手段とを備えており、
前記ＸＹステージのベース、及び、前記ＸＹステージは、反力によって生ずる振動から絶縁され、これにより、前記ＸＹステージのベース及び前記ＸＹステージの振動が、最小になるように構成されたことを特徴とするアライメント装置。

【請求項２５】　請求項２４のアライメント装置において、前記Ｘ従動子及びＹ従動子のうちのどちらか一方に設けられた前記１つのアームは、単一の平面において運動可能であり、前記Ｘ従動子及びＹ従動子のもう一方に設けられた前記一対のアームである２つのアームは、その間に前記単一の平面が位置する２つの独立した平面にそれぞれ位置し、該平面の中で運動可能であることを特徴とするアライメント装置。

【請求項２６】　請求項２５のアライメント装置において、前記１つの従動子の前記一対のアームに設けられる前記駆動部分要素手段を有し、それを制御するための手段を備え、協働する駆動主要部材手段の位置決め力に起因する、前記ＸＹステージの重心における力のモーメントのベクトル和が、実質的にゼロに等しいことを特徴とするアライメント装置。

【請求項２７】　対象物を位置決めするための方法において、

（ａ）　反作用フレームをベース上で位置決めする工程と、

（ｂ）　対象物を対象物ステージ上で支持する工程と、

（ｃ）　前記対象物を、前記反作用フレームとは独立して、対象物ステージのベースからある位置に前記対象物ステージを空間上で支持する工程と、

（ｄ）　前記対象物ステージと前記反作用フレームとの間に力を加え、前記対象物ステージを空間上の少なくとも１つの方向の新しい位置に駆動して、同時に、前記力を加えることにより生ずる反力から前記対象物ステージのベースを絶縁する工程とを備えることを特徴とする位置決め方法。

【請求項２８】　少なくとも第１の従動子及び第２の従動子によって、第１の方向及び第２の方向に動かすことにより、対象物ステージを空間に位置決めする方法において、

（ａ）　前記対象物ステージを空間に支持する工程と、

（ｂ）　前記対象物ステージと前記第１の従動子との間に力を加えて、前記対象物ステージを前記第１の方向においてのみ駆動する工程と、

（ｃ）　前記対象物ステージと前記第２の従動子との間に力を加えて、前記対象物ステージを前記第２の方向においてのみ駆動する工程と、

（ｄ）　前記第２の方向においてのみ、且つ、前記第２の従動子とは独立して、前記第１の従動子を駆動して、前記対象物ステージに追従させる工程と、

（ｅ）　前記第１の方向においてのみ、且つ、前記第一の従動子とは独立して、前記第２の従動子を駆動して、前記対象物ステージに追従させる工程とを備えることを特徴とする対象物の位置決め方法。

【請求項２９】　請求項１の位置決め装置において、前記対象物ステージと前記反作用フレームとの間で前記アクチュエータ手段を取り付けする手段を備え、該取り付けが、少なくとも駆動力方向において堅固であることを特徴とする位置決め装置。

【請求項３０】　請求項１５の位置決め装置において、前記対象物ステージと前記各従動子との間で前記アクチュエータ手段を取り付けする手段を備え、該取り付けが、少なくとも前記駆動力方向において堅固であることを特徴とする位置決め装置。

【請求項３１】　請求項２４の位置決め装置において、前記ＸＹステージと前記各従動子との間で前記アクチュエータ手段を取り付けする手段と備え、該取り付けが、少なくとも前記駆動力方向において堅固であることを特徴とする位置決め装置。

【請求項３２】　平面を有するベースプレートと、該平面な上で所定の方向に沿って運動可能なステージを有するが協働するようになされた精密位置決め装置において、

（ａ）　前記ベースプレートを基礎上に支持するための第１の支持アセンブリと、

（ｂ）　前記所定の方向に沿って前記運動可能なステージに、電磁力を与えるためのアクチュエータアセンブリとを備え、該アクチュエータアセンブリが、(i) 前記運動可能なステージに取り付けられて前記所定の方向に運動することのできる運動可能な被動部、及び、(ii) 前記運動可能なステージの周囲に位置する駆動部を具備し、(iii) 前記被動部及び前記駆動部の一方が、コイルユニットを有し、また、前記被動部及び前記駆動部の他方が、磁気ユニットを有しており、更に、

（ｃ）　前記駆動部を前記第１の支持アセンブリとは独立して前記基礎の上に支持し、これにより、前記コイルユニットと前記磁気ユニットとの間に所定のギャップを形成する、第２の支持アセンブリを備えることを特徴とする精密位置決め装置。

【請求項３３】　請求項３２の精密位置決め装置において、前記アクチュエータアセンブリの前記駆動部が、前記所定の方向に対して、静止した位置に保持されることを特徴とする精密位置決め装置。

【発明の詳細な説明】

【０００１】

【産業上の利用分野】本発明は、一般に、電気機械的な照準整合すなわちアラインメント及び振動絶縁に関し、特に、マイクロリソグラフ装置においてウエーハを支持及びアライメントし、その装置を、それ自身の反力及び外部振動から絶縁するための方法及び装置に関する。

【０００２】

【従来の技術】マイクロリソグラフ機器に使用される種々の支持機構、及び、位置決め機構が知られている。従来技術においては一般に、別個のＸガイドアセンブリ、及び、Ｙガイドアセンブリを備えるＸＹガイドが用いられており、一方のガイドアセンブリが、他方のガイドアセンブリの上に運動可能に取り付けられている。上記ガ

イドアセンブリの頂部には、別個のウエーハステージが設けられることが多い。そのような構造は、高い精度及び多くの部品を必要とする。一般に、位置決めアセンブリの部品に加わる外力、及び、上記位置決めアセンブリのその他の部品の運動に起因する反力は、像形成光学系及びレティクル（焦点板）を処理する機器に直接伝達され、その結果望ましくない振動を生ずる。

【０００３】米国特許第５，１２０，０３号（Ｖａｎ　Ｅｎｇｅｌｅｎ　ｅｔ　ａｌ．）は、光学式リソグラフ装置用の二段階式の位置決め装置を開示しており、この位置決め装置は、ローレンツ力及び静圧ガス軸受を用いている。

【０００４】米国特許第４，９５２，８５８号は、電磁アライメント装置を用いたマイクロリトグラフ装置に関するものであり、上記電磁アライメント装置は、モノリシックステージと、サブステージと、振動絶縁された基準構造とを備えており、上記モノリシックステージとサブステージとの間に設けられる力アクチュエータを用いて、上記モノリシックステージを空間上に支持し位置決めしている。この装置においては、Ｙフレームすなわちステージが、Ｘフレームに取り付けられ、また、上記モノリシックステージが、上記Ｙフレームから空間を置いて支持されている。

【０００５】

【発明が解決しようとする課題】本発明の全体的な目的は、対象物が運動する際に生ずる外力並びに反力の両方を、ウエーハの対象表面上のホトレジストに露光される像を生成するレンズ系の如き他の要素から絶縁する反作用フレームを備えると共に、上記対象物を支持するためのガイドレスステージを利用する方法及び装置を提供することである。

【０００６】

【課題を解決するための手段】本発明の装置は、対象物ステージと、ベースに取り付けられると共に、それ自身と対象物ステージとの間に振動が実質的に伝達されない反作用フレームと、上記対象物を、上記反作用フレームとは独立して空間に支持するための手段と、対象物ステージ及び反作用フレームに設けられ、対象物ステージを位置決めするための一対になって協働し、力を発生する直動型アクチュエータ手段とを備える。対象物ステージは、Ｚ方向においては空間に支持された状態で、所定の方向に運動するように設けることができ、あるいはＸ方向及びＹ方向に運動するＸＹステージを構成することができる。

【０００７】本発明の効果的な特徴は、支持、位置決め及び振動絶縁するアセンブリを提供することであり、このアセンブリは、対象物又はウエーハのステージの実行すべき位置決め機能を可能とし、その際に、反作用を受けたステージから上記ステージ及びレンズ系に伝達される振動を、少ない部品で迅速に、極めて少なくし、同時に、上記ステージに伝達される振動を最小化すると共に、上記ステージを望ましくない反力から絶縁する。

【０００８】本発明の別の特徴によれば、ＸＹステージ用の位置決め方法及び位置決め装置が提供され、上記ＸＹステージは、独立して運動可能なＸ従動子及び独立して運動可能なＹ従動子、並びに、上記ＸＹステージと各従動子との間に設けられて協働する、直動型の力アクチュエータを備えており、これにより、いずれの従動子の運動も、他方の従動子の運動を干渉しないようになされている。

【０００９】本発明の別の特徴によれば、少なくとも１つの従動子に一対のアームが設けられ、各々のアームは、駆動部材を有しており、上記アームは、対象物ステージの重心の上方及び下方に隔置された平面に位置して、該平面の中で運動可能である。

【００１０】本発明の別の特徴によれば、上記ガイドレスステージは、少なくとも３つの直動型の力アクチュエータを備えており、これらアクチュエータの２つは、Ｘ方向及びＹ方向の一方に駆動し、第３のアクチュエータは、Ｘ方向及びＹ方向の他方に駆動する。本発明の好ましい実施例によれば、ガイドレスステージは、ＸＹステージと反作用フレームアセンブリとの間に、少なくとも４つの直動型アクチュエータを備え、各々のアクチュエータは、ＸＹステージに設けられる駆動部材を有しており、これにより、一対のＸ駆動部材が、ＸＹステージをＸ方向に駆動し自動制御する役割を果たし、また、一対のＹ駆動部材が、ＸＹステージをＹ方向に駆動し自動制御する役割を果たす。直動型アクチュエータ、及び、これらの駆動部材は、協働する駆動部材の位置め力に起因する、ＸＹステージの重心における力のモーメントのベクトル和が、実質的にゼロに等しくなるように、構成され、位置決めされ、制御される。

【００１１】本発明の特徴及び効果は、全体を通じて同様の参照符号が同様の部分を示している図面を参照して、以下の説明を読むことにより、より明らかとなろう。

【００１２】

【実施例】振動絶縁反作用フレームを有するあるいは有しない、ガイドレスステージは、対象物を正確に位置決めするための多くの異なるタイプの機器に対する多くの用途を有していることは、当業者には理解されようが、本発明は、ウエーハ表面のホトレジストに露光される像をレンズが形成する装置において、ウエーハをアライメントするためのマイクロリソグラフ装置の形態の好ましい実施例に関して説明する。また、振動絶縁ステージを有するあるいは有しないガイドレスステージは、例えば、Ｘ方向又はＹ方向の一方向にだけ運動可能な、ガイドレス対象物ステージとして利用することができるが、本発明の好ましい実施例は、以下に説明するガイドレスのＸＹウエーハステージに関して説明される。

【００１３】図面、特に図１乃至図５を参照すると、上方の光学装置１２と、下方のウエーハ支持位置決め装置１３とを備えるホトリソグラフ装置１０が示されている。光学装置１２は、水銀ランプの如きランプＬＭＰと、該ランプＬＭＰを包囲する楕円面鏡ＥＭとを備える照明器１４を備えている。照明器１４は、ハエの目型のレンズＦＥＬの如き、二次光源像を生成するための光学積分器と、均一化された光束でレティクル（マスク）Ｒを照射するための集光レンズＣＬとを備えている。マスクＲを保持するマスクホルダＲＳＴが、投影光学装置１６の鏡筒ＰＬの上方に取り付けられている。鏡筒ＰＬは、絶縁パッドすなわちブロック装置２０の頂部に各々取り付けられた複数の剛性の高いアーム１８上に支持されている、柱アセンブリの一部に固定されている。

【００１４】慣性ブロックすなわち振動吸収ブロック２２が、アーム１８に取り付くように装置に設けられている。上記ブロック２２は、重量のある構造物を輸送するのを避けるために空の状態で輸送した後、操作現場で砂を充填することのできる、鋳造された箱の形態を取ることができる。対象物ステージすなわちウエーハステージのベース２８が、垂下するブロック２２、垂下するバー２６、及び、水平バー２７によって、アーム１８から支持されている（図２参照）。

【００１５】図５乃至図７を参照すると、対象物ステージすなわちウエーハステージのベース２８の上のウエーハ支持位置決め装置の平面図及び立面図がそれぞれ示されており、上記ウエーハ支持位置決め装置は、対象物（ウエーハ）ＸＹステージ３０と、反作用フレームアセンブリ６０とを備えている。ＸＹステージ３０は、サポートプレート３２を備えており、このサポートプレートの上には、１２インチ（３０４．８ｍｍ）ウエーハの如きウエーハ３４が支持されている。プレート３２は、Ｚを調節するように、すなわち、傾斜、横転及び焦点を調節するように制御することのできる、真空予圧型の空気軸受３６によって、対象物ステージのベース２８の上方の空間に支持されている。あるいは、このサポートすなわち支持を行うためには、磁石及びコイルの組み合わせを採用することもできる。

【００１６】ＸＹステージ３０はまた、直動型の駆動モータの如き磁気的な結合手段から成る適宜な要素も備えており、この要素は、ウエーハを、光学装置１６のレンズにアライメントさせ、ウエーハの表面のホトレジストを露光するための像を正確に位置決めする。図示の実施例においては、磁気的な結合手段は、ＸＹステージ３０をＸ方向において位置決めするための、Ｘ駆動コイル４２Ｘ、４２Ｘ’の如き一対のＸ駆動部材と、ＸＹステージ３０をＹ方向において位置決めするための、駆動コイル４４Ｙ、４４Ｙ’の如き一対のＹ駆動部材とから成る形態を取る。反作用フレームアセンブリ６０の上の磁気的な結合手段の関連する部分は、後に詳細に説明する。

【００１７】ＸＹステージ３０は、一対のレーザミラー３８Ｘ、３８Ｙを備えており、上記レーザミラー３８Ｘは、レーザ光線干渉計装置９２の一対のレーザ光線４０Ａ／４０Ａ’に対して動作し、また、上記レーザミラー３８Ｙは、上記干渉計装置の一対のレーザ光線４０Ｂ／４０Ｂ’に対して動作し、投影光学装置１６の鏡筒ＰＬの下方部にある固定ミラーＲＭＸに対して、上記ＸＹステージの正確なＸＹ位置を決定し且つ制御する。

【００１８】図８及び図９を参照すると、反作用フレームアセンブリ６０は、複数のサポートポスト６２を有する反作用フレーム６１を備えており、上記サポートポストは、このサポートポストと対象物ステージとの間に振動が実質的に伝達されないように、地面又は別個のベースに取り付けられている。

【００１９】反作用フレーム６１は、サポートポスト６２の間でＸ方向に伸長する面プレート６４Ｘ、６４Ｘ’と、サポートポストの間でＹ方向に伸長する面プレート６６Ｙ、６６Ｙ’とを備えている。面プレート６４－６６の内側には、複数の反作用フレームのレール６７－６９および６７’－６９’が設けられ、Ｘ従動子７２及びＹ従動子８２を支持して案内している。面プレート６４Ｘの内側には、上方の従動子ガイドレール６７、及び、下方の従動子ガイドレール６８（図示せず）が設けられており、反対側の面プレート６４Ｘ’の内側面には、上方及び下方の従動子ガイドレール６７’、６８’が設けられている。各々の面プレート６６Ｙ、６６Ｙ’の内側面には、ガイドレール６７、６８の間で垂直方向に配置された、単一のガイドレール６９、６９’がそれぞれ設けられている。

【００２０】Ｘ従動子は、隔置された一対のアーム７４、７４’を備えており、これらアームの一端部は、横材７６に固定されている。駆動トラック７８、７８’（図５参照）の如き駆動要素が、アーム７４、７４’にそれぞれ設けられ、ＸＹステージの駆動要素４２Ｘ、４２Ｘ’と協働するようになされている。図示の実施例においては、ＸＹステージの上の駆動要素４２Ｘ、４２Ｘ’は、駆動コイルとして示されているので、Ｘ従動子７２の上の駆動トラックは、磁石の形態を取っている。又、結合要素を逆転させ、コイルをＸ従動子の上にもうけ、磁石をＸＹステージの上に設けることもできる。ＸＹステージが、Ｘ及びＹ方向に駆動される際に、レーザ干渉計装置９２は、ＸＹステージのその新しい位置を瞬時に検出し、位置情報（Ｘ座標の値）を発生する。図１０を参照して後に詳細に説明するように、ホストプロセッサ（ＣＰＵ）９６に制御されるサーボ型の位置制御装置９４が、干渉計装置９２からの位置情報に応じて、Ｘ従動子７２及びＹ従動子８２の位置を制御し、駆動コイル４２Ｘ、４２Ｘ’とトラック７４、７４’との間を機械的結合することなく、ＸＹステージ３０に追従する。

【００２１】Ｘ従動子７２を反作用フレーム６１に運動

可能に取り付けるために、反作用フレーム６１の側にあるアーム７４、７４’の端部は、レール６９の上に乗って案内され、アーム７４、７４’の反対側の端部は、面プレート６６Ｙ’に隣接するレール６９’に乗っている。Ｘ従動子７２を動かすために、駆動部材７７が、横材７６の上に設けられ、反作用フレームガイド６９と協働して、ＸＹステージのＸ方向に対して直交する方向に、従動子７２を動かす。ＸＹステージ３０で正確な制御及び駆動が行われるので、Ｘ従動子７２の位置決め制御は、ＸＹステージ３０程には、正確である必要はなく、又ＸＹステージ程には、厳密な公差及びエアギャップを設ける必要はない。従って、駆動機構７７は、モータによって回転されるネジ軸、及び、Ｘ従動子７２に係合されるナットの組み合わせ、あるいは、リニアモータを形成するコイルアセンブリ及び磁石アセンブリの組み合わせとすることができ、上記各々の組み合わせは、ローラガイド機構と更に組み合わせることができる。

【００２２】Ｘ従動子７２と同様に、Ｙ従動子８２は、その一端部が横材８６に固定された一対のアーム８４、８４’を備えており、これらアームは、Ｙ駆動部材４４Ｙ、４４Ｙ’と協働するトラック８８、８８’を有している。Ｙ従動子８２のアーム８４、８４’は、別々のガイドレールの上で案内される。アーム８４の両端部は、上方のレール６７、６７’の上に乗って案内され、また、アーム８４’の両端部は、下方のレール６８、６８’の上で案内される。駆動機構８７は、Ｙ従動子８２の横材８６に設けられ、Ｙ従動子８２を、面プレート６６Ｙと６６Ｙ’との間で、ガイド６７、６７’、及び、６８、６８’に沿って、ＸＹステージのＹ方向に直交する方向に動かす。

【００２３】図９に最も良く示すように、Ｘ従動子７２のアーム７４、７４’及び横材７６’は総て、Ｚ軸線と直交する同一の平面において配置され、動く。ＸＹステージ３０の重心は、上記平面の中にあるか、又は、該平面に直ぐ隣接している。この構造においては、各々の駆動コイル４２Ｘ、４２Ｘ’からの駆動力は、アーム７４、７４’の長さにそれぞれ沿う方向に働く。しかしながら、Ｙ従動子８２のアーム８４、８４’は、Ｚ軸線に沿って互いに隔置され、それぞれは、Ｘ従動子７２を含む平面の上方及び下方にありかつ、この平面に平行な別々の平行な平面の中にあってその平面の中で動く。好ましい実施例においては、横材８６は、アーム８４’を含む下方の平面の中にあり、スペーサブロック８６’が、アーム８４及び横材８６の重なり合う端部の間に位置し、アーム８４、８４’をそれぞれの平行な平面に隔置している。Ｘ従動子７２と同様に、各々の駆動コイル４４Ｙ、４４Ｙ’からの駆動力は、アーム８４、８４’の長さに沿う方向に働く。また、駆動コイル４４Ｙ（４４Ｙ’）と駆動トラック８８（８８’）との間で、Ｘ方向及びＺ方向に所定のギャップが維持され、ガイドレスの概念を達成している。

【００２４】本発明のガイドレスステージ、及び、振動絶縁型の反作用フレームが作動する際には、ＸＹステージ３０が、干渉計装置９２によって検知された、投影レンズに対する初期位置に位置決めされ、ＸＹステージ３０は、駆動トラック７８、７８’、８８、８８’の構成による駆動要素から駆動コイル４２Ｘ、４２Ｘ’、４４Ｙ、４４Ｙ’が隔置された状態で空気軸受によって、対象物ステージのベース２８から、Ｚ方向に支持される。ＸＹステージ３０と反作用フレーム６１との間には、接触は全くない。すなわち、反作用フレームの振動が伝わって、ＸＹステージの位置に影響を与える経路、あるいは、その反対の経路は全く存在しない。信号をコイルに送る伝達手段、並びに、レーザ干渉計の位置検知装置を介する間接的な接触が存在するだけであり、上記位置検知装置は、検知した位置情報をコントローラすなわち制御装置へ送り、該制御装置は、ＸＹステージ３０の運動を生じさせる駆動信号を開始する他のコマンドを受け取る。

【００２５】干渉計装置９２からのＸＹステージの位置が分かると、駆動信号が、位置制御装置９４から、適当な駆動コイル４２Ｘ、４２Ｘ’、４４Ｙ、４４Ｙ’に送られ、ＸＹステージを新しい所望の位置へ駆動する。ＸＹステージの運動は、干渉計装置９２及び位置センサ９８Ｘ、９８Ｙ（図１０参照）によって検知され、Ｘ従動子７２及びＹ従動子８２は、それぞれ駆動部材７７、８７によって駆動され、ＸＹステージに追従する。図１０に示すように、位置センサ９８Ｘは、ＸＹステージ３０とＸ従動子７２との間のＹ方向の間隔の変動を検知し、その間隔の値を表す電気信号を位置制御装置９４へ送る。位置制御装置９４は、干渉計装置９２からのＸ位置、並びに、位置センサ９８Ｘからの信号に基づき、駆動部材７７に関する適正な駆動信号を発生する。

【００２６】また、位置センサ９８Ｙは、ＸＹステージ３０とＹ従動子８２との間のＸ方向の間隔の変動を検知し、その間隔の値を表す電気信号を発生し、駆動部材８７が、干渉計装置９２からのＹ位置の情報、並びに、位置センサ９８Ｙからの信号に基づき、駆動される。

【００２７】ヨー角度補正はヨー角度を維持あるいは補正するために使用できる、モータ対によって行われる。すなわち、上記モータ対は、ＸＹステージの回転方向の位置を変更することができる。レーザ光線４０Ａ／４０Ａ’及び４０Ｂ／４０Ｂ’の一方又は両方からのデータが、ヨー角度情報を得るために使用される。レーザ光線４０Ａ、４０Ａ’あるいは４０Ｂ、４０Ｂ’を用いた測定から得たデジタル位置データの電子的な減算を実行するか、あるいは、両者の差分を加えて２で割る。

【００２８】本発明は、ＸＹガイドを用いた場合よりも、より迅速にＸＹステージの位置決め機能を実行することを可能とする。ＸＹステージが動く際に生ずる反力

は、像形成光学系及びレティクル処理機構機器から分離される。

【００２９】本発明は、ガイドされるステージに比較して、正確なＸガイド又はＹガイドを全く必要とせず、精密なガイドがないので、ウエーハのＸＹステージの精密な組み立て及び調節の操作が減少する。ＸＹ軸線におけるリニアモータの力が、ウエーハのステージに直接作用する、つまり上記リニアモータは、ガイド装置を介して作用する必要がないので、サーボの制御帯域幅が増大する。

【００３０】ＸＹリニアモータからの力は総て、実質的にＸＹステージの重心を通して伝達させることができ、これにより、望ましくない力のモーメント（トルク）を排除する。

【００３１】互いに完全に独立して備えられ且つ作動するＸ従動子７２及びＹ従動子８２を用いて、各々の従動子７２、８２とＸＹステージ３０との間の磁気カップリングとして商業的に入手可能な電磁リニアモータを使用し、コイルと磁石駆動トラックとの間の間隙を約１ｍｍよりも小さくすると、従動子のいかなる振動も、ウエーハのＸＹステージ、あるいは、光学装置に伝達されない。また、一方の従動子のアームを他方の従動子のアームの上方及び下方に隔置すると、ＸＹステージの重心における力のモーメントのベクトル和は、協働する駆動部材の位置決め力により、実質的にゼロに等しくなる。

【００３２】ＸＹステージと各従動子ステージとの間には、これらステージの間にＸ、Ｙ、又はθの自由度で振動が伝わるのを許容する接続部が全く存在しないと考えることができるであろう。これにより、従動子ステージは、ウエーハのステージの性能に影響を与えることなく、振動する基準フレームに取り付けることができる。例えば、反作用フレームが、障害物と当たった場合には、ＸＹステージ及び投影光学装置は影響を受けないだろう。

【００３３】重心が、いずれかの２つのＸ駆動コイルといずれかの２つのＹ駆動コイルとの間で等距離にない場合には、大きさの異なる適宜な信号が、それぞれのコイルに送られてより大きな力をステージのより重たい側に与えられ、これにより、ＸＹステージを所望の位置へ駆動することは、当業者には理解されよう。

【００３４】特定の用途に対しては、電磁力を運動可能なＸＹステージに与えるための、アクチュエータすなわち磁気結合アセンブリの駆動要素４２Ｘ／４２Ｘ’又は４２Ｙ／４２Ｙ’を、Ｘ方向又はＹ方向におけるステージの運動に関して、それぞれ静止した状態で一定位置に保持することができる（図１０参照）。

【００３５】本実施例の最後の説明として、図４を再度参照して、本発明の本質的構造を説明する。図４に示すように、ＸＹステージ３０は、空気排出ポート及び真空予圧ポートを有する空気軸受３６によって、ステージベース２８の平坦で円滑な表面（Ｘ－Ｙ平面に平行な）の上に担持されており、何等摩擦を受けることなく、ステージベース２８の上でＸ、Ｙ及びθ方向に運動することができる。

【００３６】ステージベース２８は、振動絶縁ブロック２０、アーム１８、ブロック２２、垂直なバー２６、及び、水平なバー２７によって、基礎（あるいは、地面、又は、ベース構造）の上に担持されている。各々の振動絶縁ブロック２０は、基礎２１からの振動の伝達を防止する振動吸収アセンブリを備えている。

【００３７】図４は、駆動コイル４２Ｘ、４２Ｘ’をＹ方向に通る線に沿うＸＹステージ３０の断面図であるので、以下の説明は、Ｘ従動子７２に限定される。図４においては、駆動コイル４２Ｘは、従動子のアーム７４に装着された駆動トラック（Ｘ方向に細長い磁石の列）７８の磁場の中に設けられており、駆動コイル４２Ｘ’は、従動子のアーム７４’に装着された駆動トラック７８’の磁場の中に設けられている。

【００３８】２つのアーム７４、７４’は、反作用フレーム６１の内側に形成されたガイドレール６９、６９’によって、一緒にＹ方向に動くように、堅固に組み立てられている。また、ガイドレール６９、６９’は、２つのアーム７４、７４’のＸ及びＺ方向の運動を制限する。反作用フレーム６１は、４つのサポートポスト６２によって、ステージベース２８とは独立して、基礎２１の上で直接支持されている。

【００３９】従って、駆動コイル４２Ｘ（４２Ｘ’）及び駆動トラック７８（７８’）は、Ｙ及びＺ方向において所定のギャップ（数ミリメートル）を維持するように、お互いに配列されている。従って、駆動コイル４２Ｘ、４２Ｘ’が駆動されてＸＹステージ３０をＸ方向に動かすと、駆動トラック７８、７８’に生じた反力は、基礎２１へ伝達され、ＸＹステージ３０には伝達されない。

【００４０】一方、ＸＹステージ３０がＹ方向に動く時には、２つのアーム７４、７４’が、駆動部材７７によって、Ｙ方向へ動き、これにより、各々の駆動トラック７８、７８’は、位置センサ９８Ｘの測定信号に基づき、それぞれのコイル４２Ｘ、４２Ｘ’に追従し、Ｙ方向のギャップを維持する。

【００４１】本発明は、一対の駆動部材、すなわち、コイル４２Ｘ、４２Ｘ’、並びに、一対の駆動部材、すなわち、コイル４４Ｙ、４４Ｙ’を備える好ましい実施例を参照して説明したが、図１１及び図１２に示す如き、丁度３つの駆動部材すなわちリニアモータを有する本発明に従って振動絶縁反作用フレームと、ガイドレスステージを構成することができる。図１１に示すように、一対のＹ駆動コイル１４４Ｙ、１４４Ｙ’が、ステージ１３０に設けられ、また、単一のＸ駆動コイルすなわちリニアモータ１４２Ｘが、ＸＹステージの重心ＣＧ’に合

わせて設けられている。Ｙ駆動コイル１４４Ｙ、１４４Ｙ’は、Ｙ従動子１８２のアーム１８４、１８４’に設けられ、また、Ｘ駆動コイル１４４Ｘは、Ｘ従動子１７２のアーム１７４”に設けられている。適宜な駆動信号を駆動コイル１４２Ｘ、１４４Ｙ、１４４Ｙ’に与えることにより、ＸＹステージを所望のＸＹ位置へ動かすことができる。

【００４２】次に、図１３乃至図１６を参照すると、本発明の別の実施例が示されており、この実施例は、ＸＹ駆動コイル２４２Ｘ、２４２Ｘ’、２４４Ｙ、２４４Ｙ’とＸＹステージ３０’への取付部との間に、リンクを備えている。これらの結合部は、駆動コイル２４４Ｙを結合部材３２０の一端部に結合する複式の板ばねアセンブリ３００と、結合部材３２０の他端部をＸＹステージ３０’に結合する複式の板ばねアセンブリ３２０とを備えている。複式の板ばねアセンブリ３００は、コイル２４４Ｙに固定されたフランジ３０２を有している。クランプ部材３０４が、クランプボルトを介して、フランジ３０２に取り付けられており、水平な可撓性のリンク３０６の一方の縁部をその間に挟んでいる。可撓性のリンク３０６の他端部は、２つの水平な部材３０８の間に挟まれており、これら水平な部材は、順に垂直なフランジ３１０と一体に固定され、この垂直なフランジには、一対のフランジ部材３１２がボルト止めされており、該一対のフランジ部材は、垂直な可撓性の部材３１４の一方の縁部を挟んでいる。垂直な可撓性の部材３１４の他方の縁部は、一対のフランジ部材３１６の間に挟まれており、該一対のフランジ部材は、順に固定部材３２０の一端部のフランジプレート３１８にボルト止めされている。固定部材３２０の他端部では、プレート３４８が、２つのフランジ部材３６に固定されており、これら２つのフランジ部材は、垂直な可撓性の部材３４４の一端部を挟むように互いにボルト止めされている。垂直な部材３４４の反対側の縁部は、フランジ部材３４２によって挟まれており、これらフランジ部材は、順に水平な可撓性の部材３３６の一方の縁部を挟む一対のクランププレート３３８に固定されたプレート３４０に固定されており、上記水平な可撓性の部材の反対側の縁部は、プレート３３４の助けを受けて、ＸＹステージ３０’に挟み付けられている。従って、各々の複式の板ばねアセンブリ３００、３３０においては、水平な及び垂直な可撓性の部材の両方を設けることにより、振動が減少される。これら各々のアセンブリにおいては、垂直な可撓性の部材が、Ｘ、Ｙ及びθの振動を減少させ、また、水平な可撓性の部材が、Ｚ、傾斜及び横転方向の振動を減少させる。従って、Ｘ、Ｙ、θに関する、８つの垂直方向のたわみジョイント、並びに、Ｚ、傾斜及び横転方向に関する、８つの水平方向のたわみジョイントが設けられる。

【００４３】図１６に示すように、コイル２４４Ｙは、コイルサポート２４５Ｙに取り付けられ、該コイルサポートは、これに取り付けられた上方のサポートプレート２４６を有しており、該上方のサポートプレートは、磁気トラックアセンブリ２８８の頂部に乗っている。真空予圧型の空気軸受２９０が、一方としてコイルサポート２４５Ｙと上方のサポートプレート２４６と、また、他方として磁気トラックアセンブリ２８８との間に設けられている。図１３乃至図１６に示す実施例の作動例においては、可撓性の部材３０６、３１４、３４４、３３６は、幅が約３１．８ｍｍ（１　１／４インチ）、長さが約６．４ｍｍ（１／４インチ）及び厚みが０．３０５ｍｍ（０．０１２インチ）のステンレス鋼であり、その一次たわみ方向は、厚みの方向である。図示の実施例においては、部材３０６、３１４は、それぞれの一次たわみ方向を互いに直交差せた状態で、直列に配列されており、部材３４４、３３６も同様に配列されている。

【００４４】本発明を好ましい実施例に関して説明したが、本発明は多くの異なる形態を取ることができ、本発明の範囲は、請求の範囲によってのみ限定されるものである。

【図面の簡単な説明】

【図１】本発明を採用したマイクロリソグラフ装置の斜視図である。

【図２】図１において線Ａ－Ａで示す構造の一部の斜視図であって、図１に示す反作用ステージは省略してある。

【図３】図１に示す構造を一部断面で示す立面図である。

【図４】本発明の対象物位置決め装置を一部断面で示す概略的な立面図である。

【図５】反作用ステージ上方にあるウエーハのＸＹステージ位置の平面図である。

【図６】図５に示す構造の一部を線６－６に沿って矢印の方向に示す側方立面図である。

【図７】図６において線Ｂ－Ｂで示す構造の一部の拡大図である。

【図８】ＸＹステージの位置決めを行うためにＸＹステージに固定された手段を取り除いてＸＹ従動子を示す、反作用ステージの斜視図である。

【図９】図８に示すＸＹ従動子の拡大斜視図である。

【図１０】本発明の好ましい実施例の位置検出及び制御装置の概略的なブロックダイアグラムである。

【図１１】本発明の別の実施例を示す、図５と同様な平面図である。

【図１２】図１１の実施例を示す、図６と同様な側方立面図である。

【図１３】本発明の更に別の実施例を示す、図５と同様な平面図である。

【図１４】図１３の実施例を示す、図６と同様な側方立面図である。

【図１５】図１３に示す構造の一部の拡大上面図であ

る。

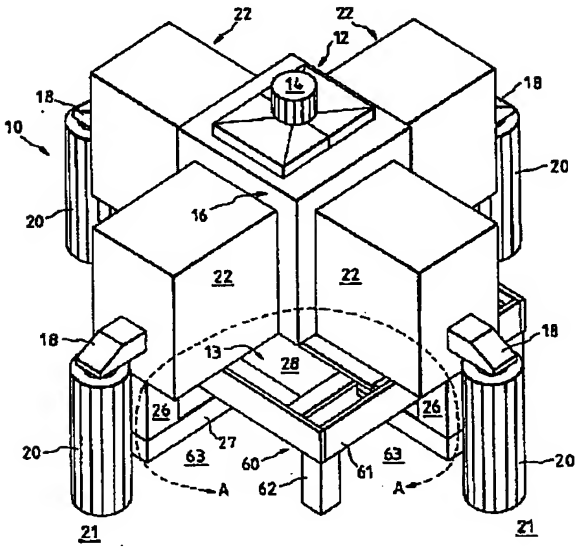
【図１６】図１５の線１６－１６に沿って矢印の方向に示す上記構造の端面図である。

【符号の説明】

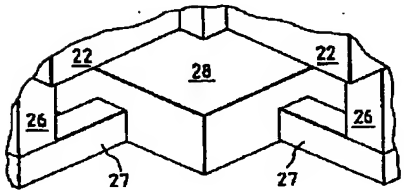
１０　ホトリソグラフ装置
１２　光学装置（光学系）
２８　対象物ステージのベース
３０　ＸＹステージ
３４　対象物（ウエーハ）

３６　空気軸受
４２Ｘ，４２Ｘ’　Ｘ駆動部材（Ｘ駆動コイル）
４４Ｙ，４４Ｙ’　Ｙ駆動部材（Ｙ駆動コイル）
６０　反作用フレームアセンブリ
６１　反作用フレーム
７２　Ｘ従動子
７４、７４’　Ｘ従動子のアーム
８２　Ｙ従動子
８４、８４’　Ｙ従動子のアーム

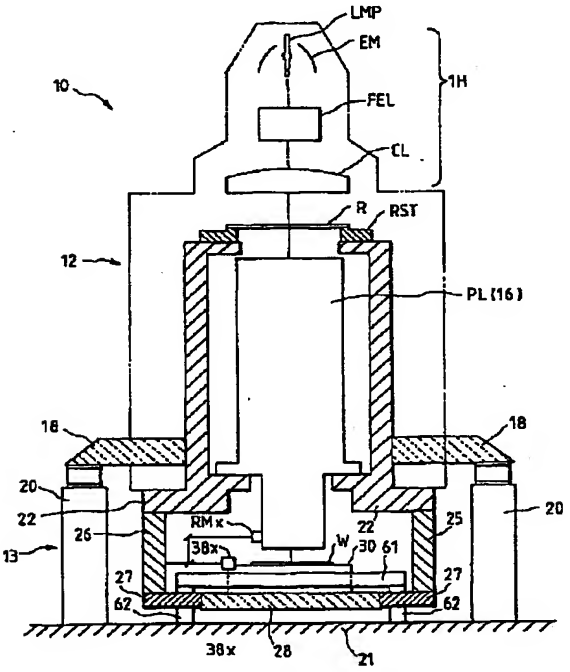
【図１】



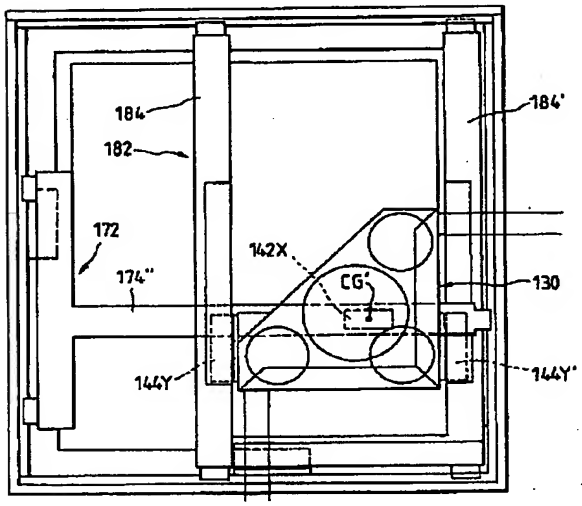
【図２】



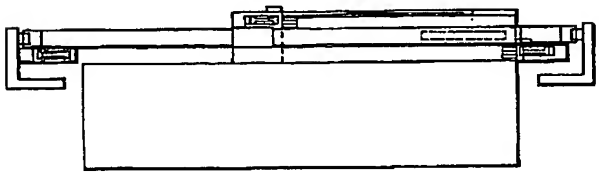
【図３】



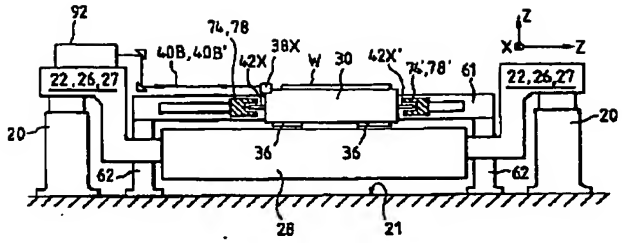
【図１１】



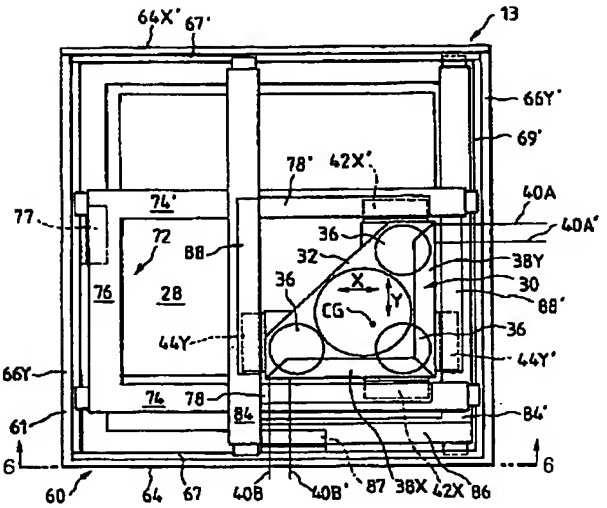
【図１４】



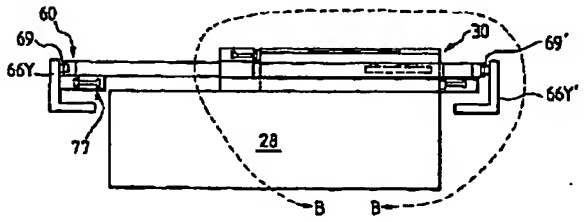
【図４】



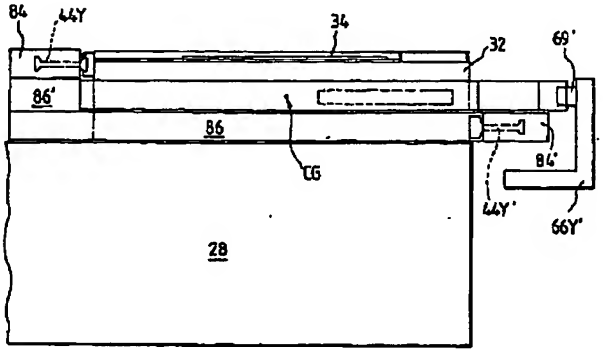
【図５】



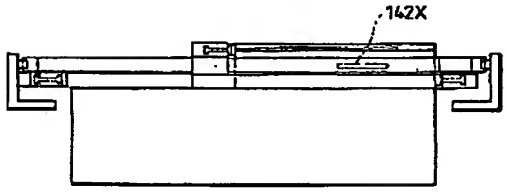
【図６】



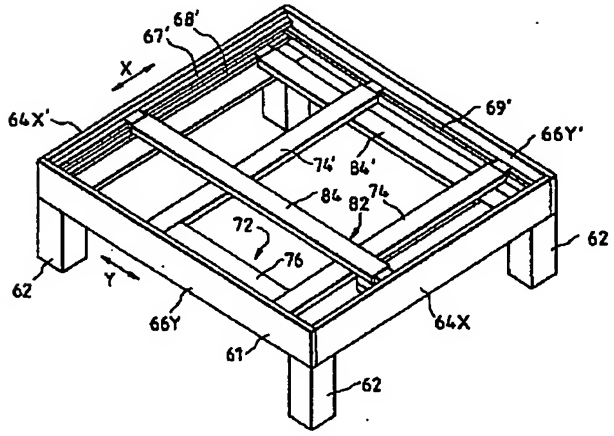
【図７】



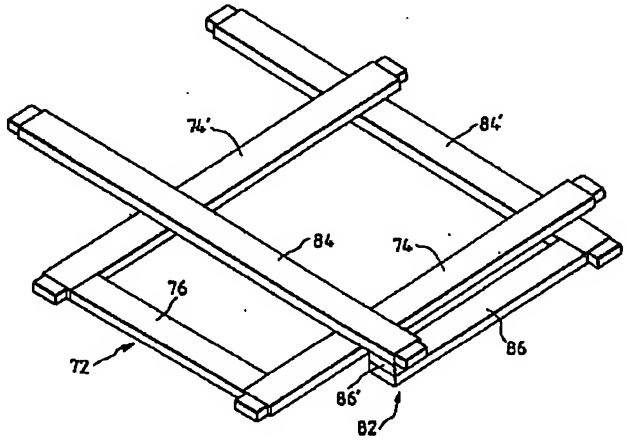
【図１２】



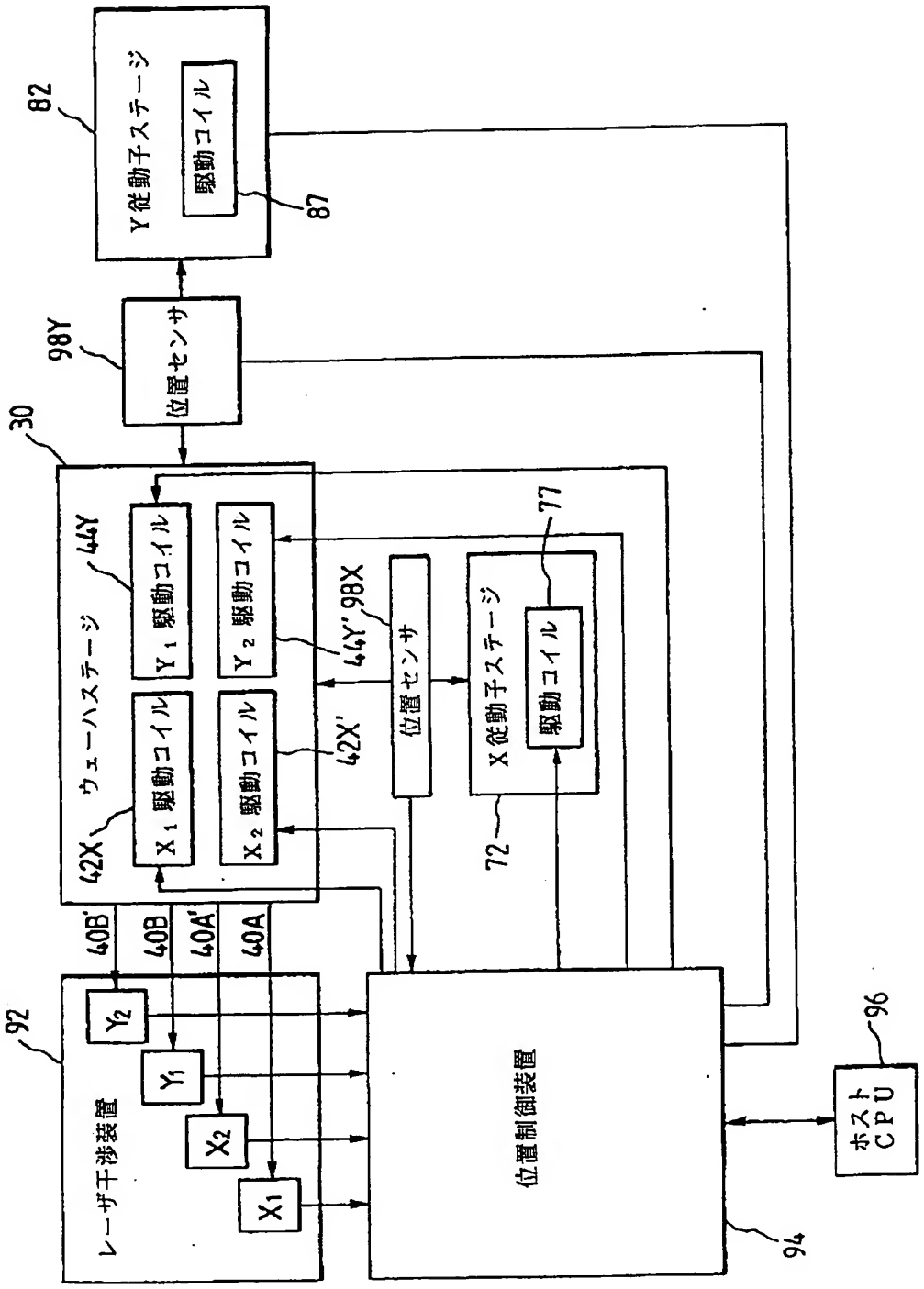
【図８】



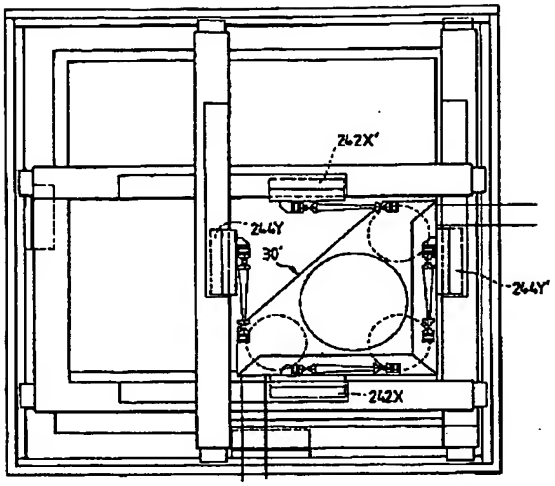
【図９】



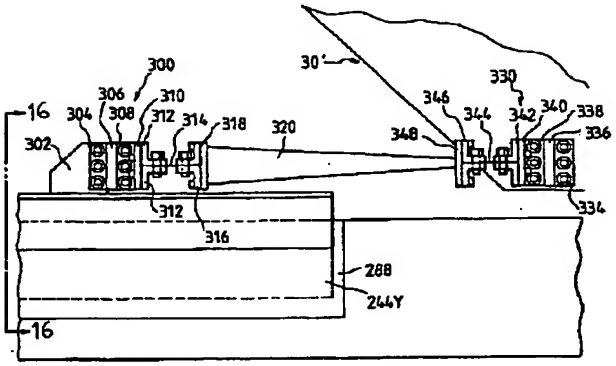
【図１０】


82
Y従動子ステージ
駆動コイル
87
98Y
位置センサ
30
ウェーハステージ
44Y
Y1 駆動コイル
Y2 駆動コイル
42X
X1 駆動コイル
X2 駆動コイル
42X'
44Y'
98X
位置センサ
77
X従動子ステージ
駆動コイル
72
40B'
40B
40A'
40A
92
レーザ干渉装置
Y2
Y1
X2
X1
位置制御装置
94
96
ホスト
CPU

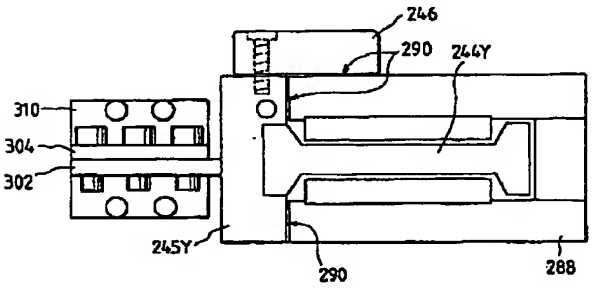
【図１３】


242X'
244Y
30'
244Y'
242X

【図１５】


300
30'
330
306
310
346
16
304
308
312
314
318
320
340
338
344
342
348
336
302
312
334
316
288
244Y
16

【図１６】


246
290
244Y
310
304
302
245Y
290
288